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Part 1

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TP 4143, pt. 1
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STORAGE TEMPERATURE OF EXPLOSIVE HAZARD MAGAZINES

Part 1. AMERICAN DESERT

by

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ABSTRACT. Temperature measurements (162,000 data points) from the "explosive hazard magazines" in the desert regions of the Western United States at Yuma, Arizona, China Lake, California, and Hawthorne, Nevada, were assessed for the purpose of establishing temperature limit criteria by statistical methods for ordnance stored in hot desert magazines. This study shows that in the storage magazine environment, the 165°F specification temperature is grossly unrealistic. This report includes 17 figures and 14 tables.

U.S. NAVAL ORDNANCE TEST STATION
China Lake, California
November 1966

39

U. S. NAVAL ORDNANCE TEST STATION

AN ACTIVITY OF THE NAVAL MATERIAL COMMAND

J. I. HARDY, CAPT., USN
Commander

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Technical Director

FOREWORD

This effort was undertaken to determine the valid temperature environment of ordnance stored in "explosive hazard magazines" located in desert areas. The magazines discussed in this report are continuously exposed to solar excursions that can cause the most extreme upper temperatures that can be experienced in standard igloo storage. No other environment, including tropical, causes equally high ordnance temperatures.

It is expected that there will be sufficient interest generated among ordnance designers to warrant further work in the study of storage temperature in other areas of interest; i.e., tropics, marine-induced arctic, etc. This is the first of a series of reports.

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This report has been reviewed for technical accuracy and completeness by John P. Saitz and John P. Vanderbeck.

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CONTENTS

INTRODUCTION

Environmental temperature criteria are a major controlling factor in the design of all types of ordnance. However, the accepted temperature criteria, as set forth in Military Specifications, may be such that there are ordnance that actually meet the needs of our Naval services and yet have failed over-strenuous qualification requirements. It is important then, that the actual temperature environment of ordnance be studied to substantiate existing temperature specifications or to revise the limitations in accordance with the true findings.

This report covers a comparatively small area of the storage environment of explosive ordnance. Storage temperatures (162,000 data points) were obtained from Army and Navy facilities located in the desert regions of the Western United States, in order to preliminarily study high temperatures within storage magazines. These data points were obtained by the personnel at the Naval Ammunition Depot (NAD), Hawthorne, Nevada, the Naval Ordnance Test Station (NOTS), China Lake, California, and the Army Proving Ground, Yuma, Arizona, for use in their ammunition safety programs. The data were not originally meant for the purpose to which they are herein used. The information does, however, lend itself to the project at hand satisfactorily when placed in proper context.

Maximum temperatures were studied more thoroughly than minimum temperatures because it is assumed that the high temperatures encountered in the desert regions are primarily detrimental to ordnance.

BACKGROUND

After the decision to conduct this study in magazine temperatures was made, the first effort was expended in locating any available pertinent data. The Navy OP 5[1] sets forth a definite requirement for the maintenance of magazine temperature records. Temperature records were, therefore, readily at hand from the magazine area at NOTS. Investigation revealed that NAD, Hawthorne, Nevada, ("The World's Largest Naval Ammunition Depot") maintained a similar temperature record system. These data were accessible for the NOTS investigation.

A third source of storage temperature data was found at the Army Proving Ground, Yuma, Arizona. Army regulations do not specifically require temperature recording on any fixed basis; however, there is a safety requirement that an inside temperature reading of 100°F in any magazine makes necessary the "wetting down" of the magazine exterior. This led to the temperature recording system evolved at Yuma.

The Naval magazines temperature data must be retained on station for a period of one year. Thereafter, the information may be destroyed. It has been found, however, that at most of the major Naval Ammunition Depots, the records are informally retained for a much longer period of time.

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[1] Ammunition Ashore, Handling, Stowing and Shipping, Vol. 1, 2nd Revision.

The Army conducts a similar program at the Yuma Proving Ground. The Yuma Proving Ground Safety Office requires a temperature recording procedure similar to that of the Navy OP 5. Temperature records for the Proving Ground are retained by both Yuma and the Army Electronic Research and Development Command, Fort Huachuca, Arizona. In addition, Yuma keeps temperature records on two structures that are not explosive hazard magazines. One structure (JATO) is an above-ground open-vented corrugated steel building with no protective insulation. The other (X-Site) is a wood-framed tarpaulin-covered shed-like structure open on both sides.

INSTRUMENTATION

The Navy magazine temperature data were obtained through the use of Federal Standard "horseshoe" maximum and minimum mercury thermometers (FSN 6685-243-9965). These thermometers are equipped with steel "tattletale" devices that float on the mercury and remain at the highest and lowest temperature positions reached during the measurement period. The ordnanceman resets the tattletales with a magnet after reading the indicated maximum and minimum temperature for the measurement period. The manufacturers of the thermometers warrant that the temperature readings are accurate within 2°F. These thermometers are generally mounted on the inside forward face of the magazine at about eye level. The larger magazines may have a second thermometer mounted on the rear inner wall of the same chamber. The triple-arch type magazine has at least three thermometers, one per "arch" or closed section of the magazine.

The Army data were obtained through the use of continuous recording, clock-motor-driven, hygrothermographs. This is an easily portable instrument that continuously records temperature and humidity. The unit is randomly placed in the magazine, depending on the quantity of ordnance in the magazine. If the magazine is empty, the unit is placed on the floor. If the magazine is completely full, the unit is placed on the stacked ordnance near the roof adjacent to the door. The temperature measurement depends on the action of a bimetal strip. The two metals, bonded side by side, are exposed to a given thermal energy level. The metals expand at different rates, deforming their common alignment. This deformation causes the pen on the remote recording device to change positions on the calibrated chart paper, thus recording the temperature fluctuation. The accuracy of this type of instrument is not usually as precise as a mercury thermometer, but it is well within the tolerances necessary for this type of work. The major variable in these measurements results from the height of the instruments within the magazine, which can and does at times change daily. (As ammunition stacks are used or replenished, the hygrothermograph is set on the stack of ammunition. This accounts for the changing heights of the temperature measuring device.) The thermal gradient in a magazine from top to bottom is significant. Therefore, the data from this measuring system are not as controlled as those from the fixed position Navy installations.

METHOD OF DATA RETRIEVAL AND REDUCTION

All available storage magazine temperature data from the installations at China Lake, Hawthorne, and Yuma, were collected and sent to the Analysis Branch, Propulsion Development Department, at NOTS. The raw data were reduced to meaningful statistics. The significant points of interest for each location were tabulated. These were (1) the number of the measured temperatures exceeding nominal temperatures for each month, (2) the average maximum, average minimum temperatures for each month, and (3) the standard deviation of the maximum temperatures and the standard deviation of the minimum temperatures for each month.

In general, the raw data input consisted of summary sheets of the maximum and minimum temperatures organized generally by magazine area, magazine type, and the date of the readings. The information on the summary sheets was transferred to IBM punchcards. A computer was then used to reduce this information into the necessary statistics previously mentioned. The steps by which the raw data were processed are explained in detail in Appendix A. A description of the magazine classifications pertinent to this report is given in Appendix B.

RESULTS

A summarization of all the data points exceeding nominal temperatures for the three desert magazine locations was made and is presented in Table 1.

TABLE 1. Data Summary by Station

Storage location	Years[a]	N[b]	Percentage of maximum temperatures greater than or equal to						
			80°F	90°F	100°F	105°F	110°F	115°F	117°F
China Lake	3	22,387	44.3	17.8	0.0	0.0	0.0	0.0	0.0
Nevada	5	33,881	28.7	0.1	0.0	0.0	0.0	0.0	0.0
Yuma	7	11,208	51.5	33.3	10.3	2.0	0.4	0.03	0.0

[a] Length of time in complete calendar years.

[b] Number of data points represented in the sampling.

It is interesting to note that at neither China Lake nor Hawthorne did magazine temperatures exceed 100°F during their time coverage. The detailed monthly breakdowns from which the data on Table 1 were summarized are presented in Appendix C.

The average maximum and minimum temperatures of each month for each of the three magazine sites are plotted in Fig. 1-3. The upper lines represent the observed average maximums and the lower lines represent the observed average minimums.

Figure 1 includes the years 1960 and 1963-1965 for China Lake. Data were not available for the calendar years 1961 and 1962 or September and October of 1965.

Figure 2 presents the continuous temperatures for the years 1959-1964 at Hawthorne. Due to the tremendous size of the installation at NAD, Hawthorne, only the data from areas 112 and 113 were used. The records from these areas are representative of all records from other magazines of the explosive hazard classification at NAD and differ only in the sampling frequency.

The temperature graph for Yuma, as shown in Fig. 3, is continuous for calendar years 1958-1964. These Army Proving Ground data represent a larger variety of storage conditions than those at either Navy installation.

The data from which the plots of Fig. 1-3 were taken are included in Appendix D. These include the number of measurement points from which the averages were computed, the averages, and the standard deviations. The importance of reporting these data and the implications arising therefrom are discussed in Appendix E.

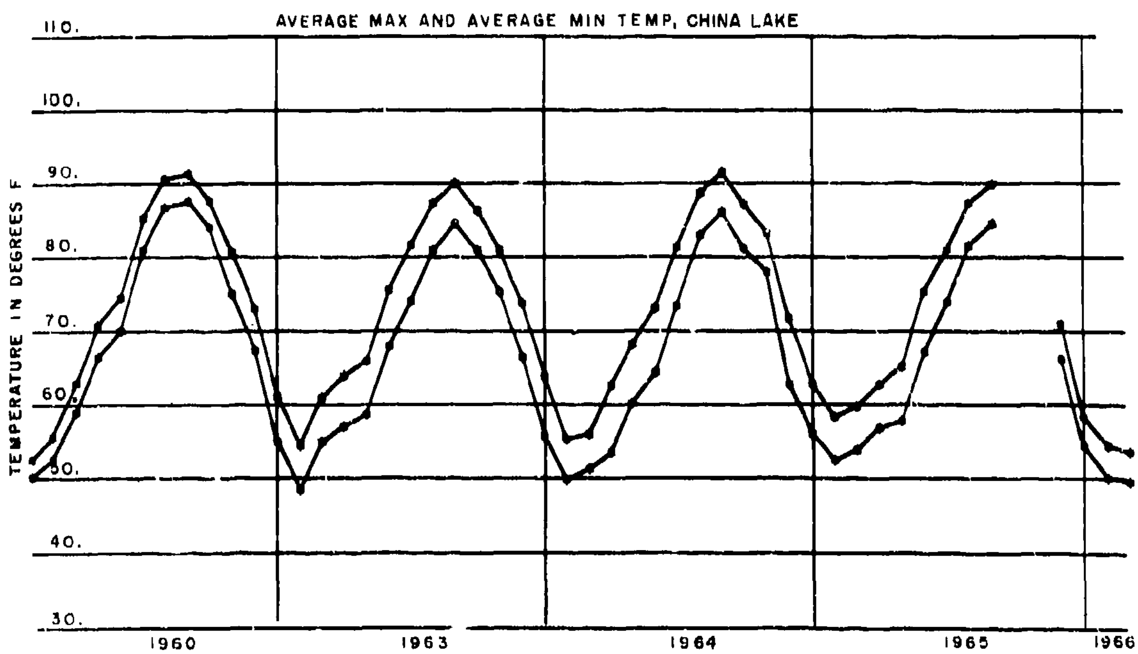

FIG. 1. Average Temperature, NOTS, China Lake, California

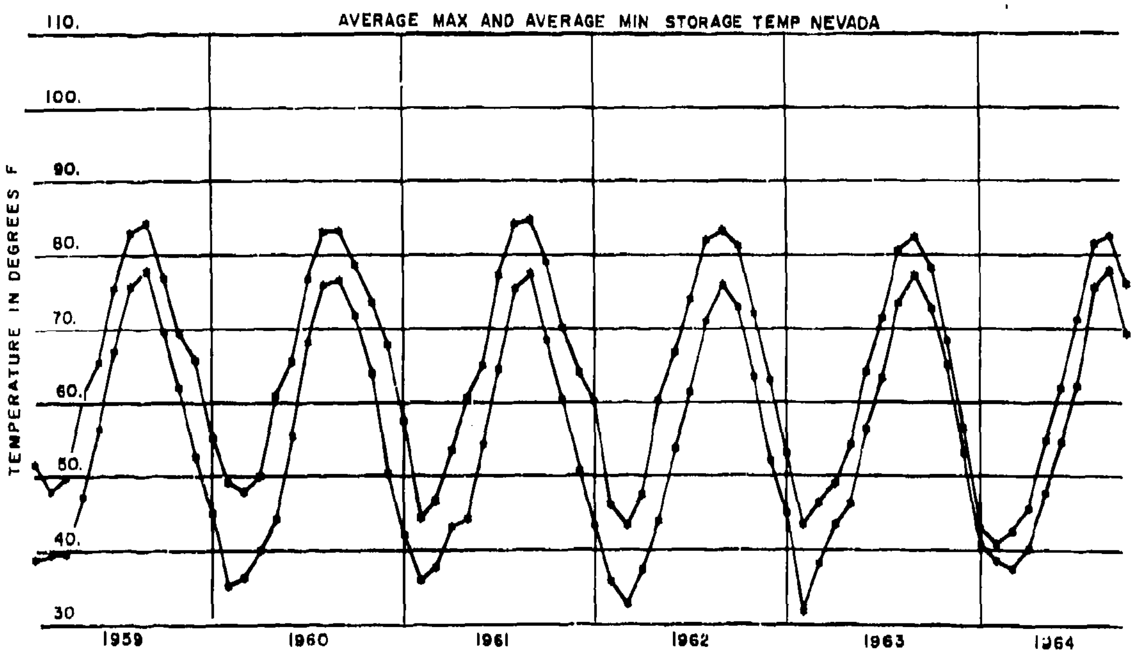

FIG. 2. Average Temperature, NAD Hawthorne, Nevada.

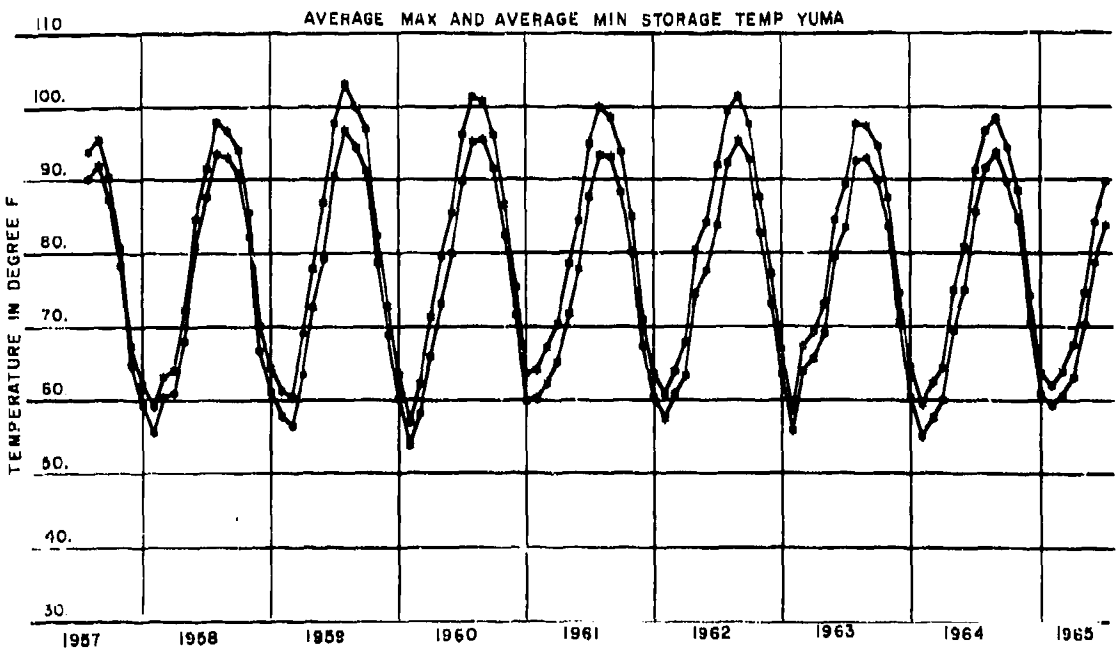

FIG. 3. Average Temperature, Yuma Proving Ground, Arizona.

Part 1

The China Lake magazine storage temperatures, during the summer months, are approximately 8°F higher (statistically significant) than the magazine temperatures measured at Hawthorne, Nevada. This difference can be attributed primarily to location because the magazines are similar in construction. However, all of the approximately 10°F higher (statistically significant) Yuma magazine temperatures, as compared with the China Lake magazine temperatures during the summer months, cannot be attributed to location alone. Although all of the storage magazines at Yuma are earth-covered, as are the storage magazines at both China Lake and Hawthorne, the construction of the storage magazines, the temperature measuring devices, and the location of these devices within the storage magazines are not the same. An inspection of these magazines will reveal that the temperatures at Yuma would have been lower had the construction of the magazines and the temperature measuring procedures been the same as those at both China Lake and Hawthorne.

The peak temperatures from the JATO and X-Site structures for the year 1961 were 119°F and 121°F respectively. These peaks were recorded on 14 June which was not the same date as other Yuma magazine peak temperature dates. The buildings are shown and the temperature data are given separately in Appendix F.

CONCLUSIONS

Assuming that the data are representative of the desert storage depot magazine temperatures, the results indicate that ordnance, explosives, propellants, pyrotechnics, etc., stored in these explosive hazard magazines will probably never be subjected to temperatures greater than 120°F (or less than 15°F).

It has been found (Appendixes B and F) that the type of storage structure determines, to some extent, the storage temperatures. The temperature differences are, however, such that further detailed study of structure effects on temperatures is not warranted at the present time. The maximum temperature (121°F), recorded in the X-Site, is nowhere near the existing storage specification of 165°F. The fact that such shelters as X-Site can protect the ordnance from heat to the degree shown suggests that such primitive shelters would be advantageous for temporary usage. The allowance of air circulation and denial of direct solar insolation thus afforded would be a very serviceable field expedient in protecting the ordnance against excessively high temperatures.

RECOMMENDATIONS

This report covers only those storage environments in the desert regions of the Western United States. In order to make general statements about storage temperatures, temperature data from many other storage locations, such as the tropics and the arctic, should be collected and studied. It would then be useful to make probability statements relating to nominal storage temperatures.

Data from which this report was written were collected during the latter peak of the solar cycle. Temperature data from a minimum 11-year period need to be encompassed to give a more complete statistical awareness of the explosive hazard magazine.

This report should be used as a basis for the continuation of this program. This, and oncoming similar work should be used as a basis for the updating of the storage temperature requirements of the Military Specifications to which ordnance are designed.

Appendix A

DATA HANDLING

The procedure for handling the storage temperature data is as follows:

Step 1. The applicable data are keypunched onto IBM type cards from the temperature summary sheets as received from the ammunition storage facility as shown in Table 2.

TABLE 2. Punchcard Data.

	Month	Day	Year	Storage location	Type of magazine	Location of thermometer in magazine	Temp reading	
							Low	High
Example	06	22	64	C. L.	1XC-4	Front	092	102
Card Column	3 ——— 8			10-16	18-26	28-32	36-38	42-44

Step 2. The punched cards (step 1) are sorted in the following manner.

a. Storage location: China Lake, (C. L.), Nevada (NEV.), and Yuma (Yuma)

b. Each group of cards by location into calendar sequence by:

(1) Year
(2) Month
(3) Day

Step 3. The "input deck" consists of: (1) IBM 7094 computer program (162-52), (2) the sorted cards from step 2, and (3) a "total card" with the number of months of data included in columns 4 and 5. The computer program, 162-52, computes the averages and standard deviations of maximum and minimum temperatures of each month.

Step 4. The resulting output from step 3 consists of the output deck with averages and standard deviations of maximum and minimum temperatures punched in the cards as shown in Fig. 4. Microfilms containing data for each month, as sorted in step 2, are processed by the computer. Figure 5 is a photographic reproduction of a typical microfilm.

Step 5. The output deck created in step 4 is reproduced on aperture cards. The microfilm of step 4 is cut in segments and inserted in the aperture card as shown in Fig. 6.

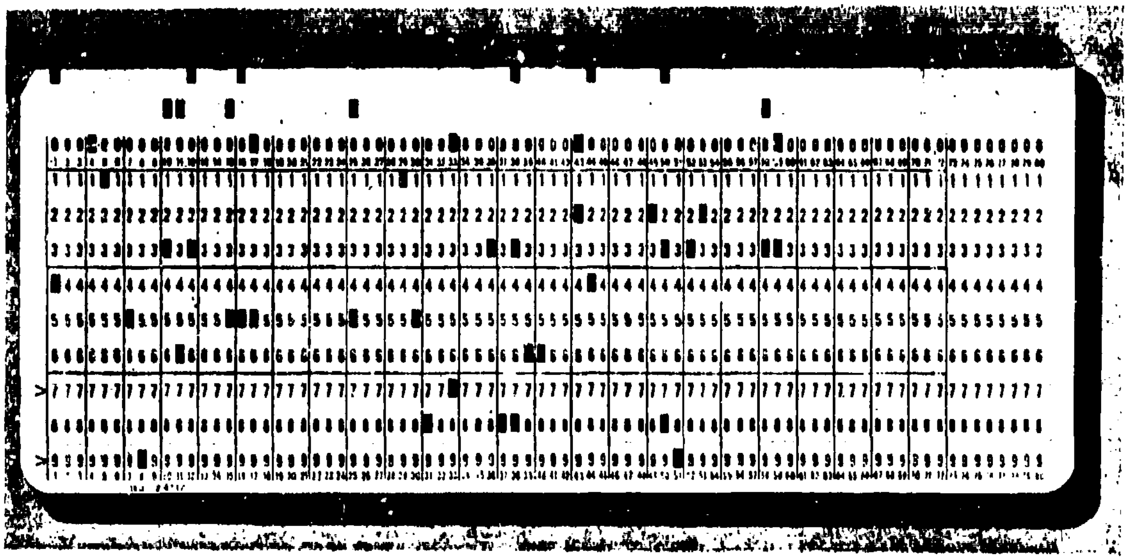

FIG. 4. Typical Data Card.

LOW TEMPERATURES

DATE = 01 59 LOCATION = NEV

N = 158 MEAN = 38.66 STANDARD DEVIATION = 2.932

37.	38.	35.	37.	38.	37.	38.	37.	33.	36.	37.	36.	35.	36.	40.	37.	36.	37.	35.
36.	35.	36.	36.	36.	38.	38.	38.	38.	37.	35.	38.	37.	36.	38.	36.	38.	40.	37.
35.	37.	36.	37.	36.	38.	38.	35.	37.	36.	36.	37.	36.	36.	36.	35.	36.	37.	37.
35.	36.	40.	37.	36.	37.	37.	32.	36.	37.	46.	36.	40.	39.	37.	36.	37.	38.	36.
40.	38.	36.	36.	41.	40.	40.	40.	38.	40.	38.	41.	40.	39.	41.	40.	41.	41.	37.
36.	38.	40.	38.	39.	37.	37.	38.	37.	38.	39.	41.	40.	41.	44.	40.	40.	40.	42.
40.	41.	41.	43.	41.	41.	42.	40.	40.	38.	38.	37.	37.	40.	40.	40.	40.	42.	40.
38.	40.	40.	41.	41.	40.	38.	40.	38.	41.	42.	41.	41.	43.	42.	40.	42.	41.	40.
39.	41.	39.	56.	45.	41.													

FIG. 5. Typical Microfilm Data.

Step 6. The output deck is assembled with another IBM 7094 computer program (162-53) and fed to the computer. The output from the computer is a curve such as that illustrated in Fig. 1 which plots the average maximum and minimum temperatures for the effective dates of the output deck knowledge.

Step 7. The data sorted in accordance with step 2 is manipulated to produce the number of temperature readings taken and the number of days of the month on which the readings were taken. Table 3 is an example of this information.

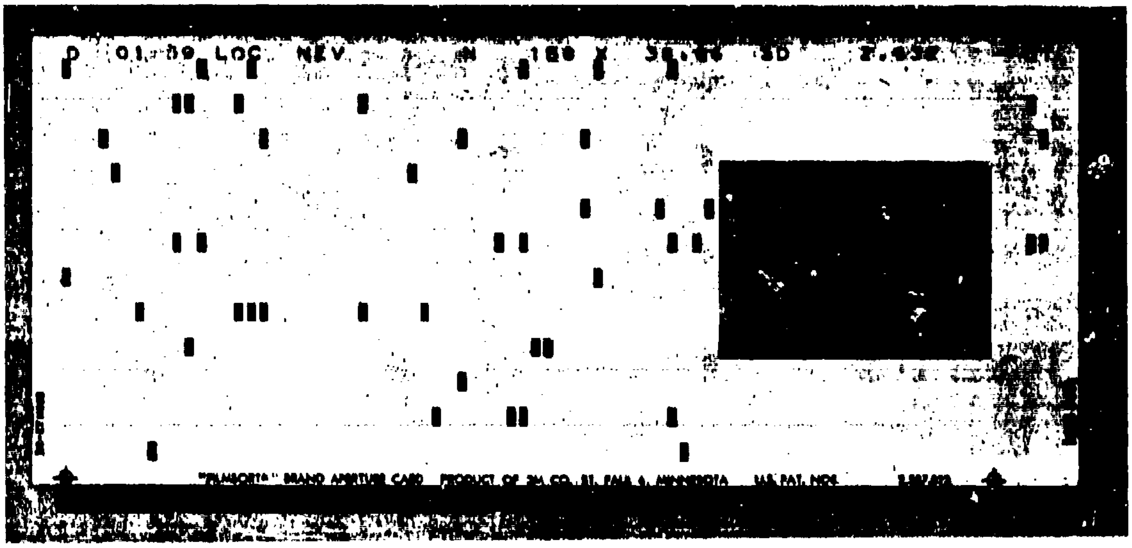

FIG. 6. Aperture Card With Microfilm Insert.

TABLE 3. Data Point Summary by Month

Year	Month	N[a]	The number of data points greater than or equal to						Reading times
			80°F	90°F	100°F	105°F	110°F	115°F	
1960	Jul	1540	1539	1019	0	0	0	0	20

[a]Number of readings

The flow chart in Fig. 7 depicts the data handling system for storage temperature information.

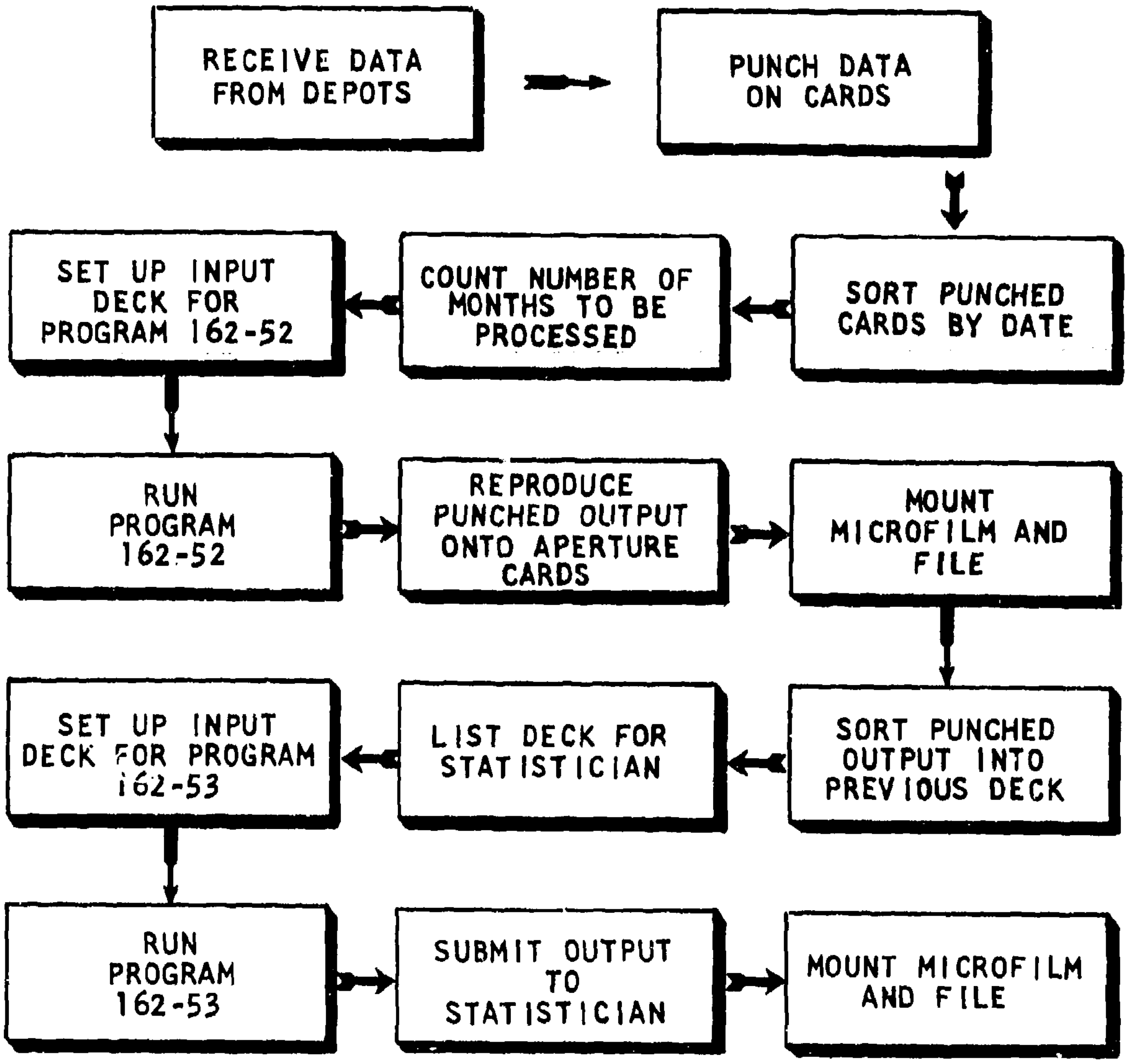

FIG. 7. Data Handling Sequence Chart.

Appendix B

CLASSIFICATION OF MAGAZINES

Storage magazines differ in construction for the type of ammunition that is to be stowed. The Navy storage magazines from which all of the temperature data have been collected are classified as explosive hazard magazines and their construction labeling, maintenance, location of thermometers, etc., and the frequency at which temperature measurements were taken are in accordance with OP 5, Vol. 1, second revision. The Army magazines are all earth-covered but in some cases do not meet Navy standard requirements.

NOTS, CHINA LAKE

There are 47 ammunition storage magazines at NOTS, China Lake, from which the temperature data were taken. The different types and number of each are listed in Table 4.

The thermometers are located so that the highest temperature within the magazine at eye level will be recorded when only one thermometer is installed. When two thermometers are used, the second is located, also at eye level, in a position to show the greatest variation from the first instrument. One thermometer is always located on the front inside wall near the door. The second instrument when used is generally at the rear of the magazine.

Typical AT and XC type magazines are shown in Fig. 8 and 9, respectively.

NAD, HAWTHORNE

Temperature data were taken from only 179 storage magazines at NAD, Hawthorne. These installations are in Areas 112 and 113 and consist of PC rectangular and PC triple-arch magazines. The two types and numbers of each are listed in Table 5.

Each PC retangular magazine (Fig. 10) has a thermometer located adjacent to each of the two doors. The insert in Fig. 10 shows the interior of the PC rectangular magazine.

The triple-arch magazine (Fig. 11) is actually three magazines of 25 x 80 x 14 feet that are constructed contiguous to each other. Each of the three magazine sections has one door and one thermometer near the door at a height of approximately 5 feet, or eye level.

TABLE 4. Storage Magazines at China Lake.

Type	Number	Size[a], ft	Thermometers installed	Description
XT	2	20 x 20 x 10	1	Corrugated multiplate arch, concrete floor, concrete front, steel rear, 2-foot earth-covered. Concrete barricade in front.
XT	1	14 x 20 x 7	1	
XT	8	14 x 25 x 8	1	Corrugated multiplate arch, concrete floor, concrete front, concrete rear, 2-foot earth-covered. Concrete barricade.
XC	8	14 x 50 x 8	1	Corrugated multiplate arch, concrete floor, concrete front, concrete rear, 2-foot earth-covered. No barricade in front.
AT	28	25 x 80 x 14	2	Reinforced concrete arch, concrete floor, concrete rear, 2-foot earth-covered. Cement barricade in front.

[a]Dimensions listed are width, length, height, in that order.

TABLE 5. Storage Magazines at Hawthorne.

Type	Number	Size[a], ft	Thermometers installed	Description
PC	106	Rectangular 100 x 50 x 14	2	Reinforced concrete roof, cement floor, cement walls, and 2-foot earth-covered. No barricade in front.
PC	73	Triple-arch 75 x 80 x 14	3	Reinforced concrete arches, concrete floor, concrete rear, concrete front, 2-foot earth-covered. No barricade in front.

[a]Dimensions listed are width, length, and height, in that order.

FIG. 8. XC Magazine, China Lake.

FIG. 9. AT Magazine, China Lake.

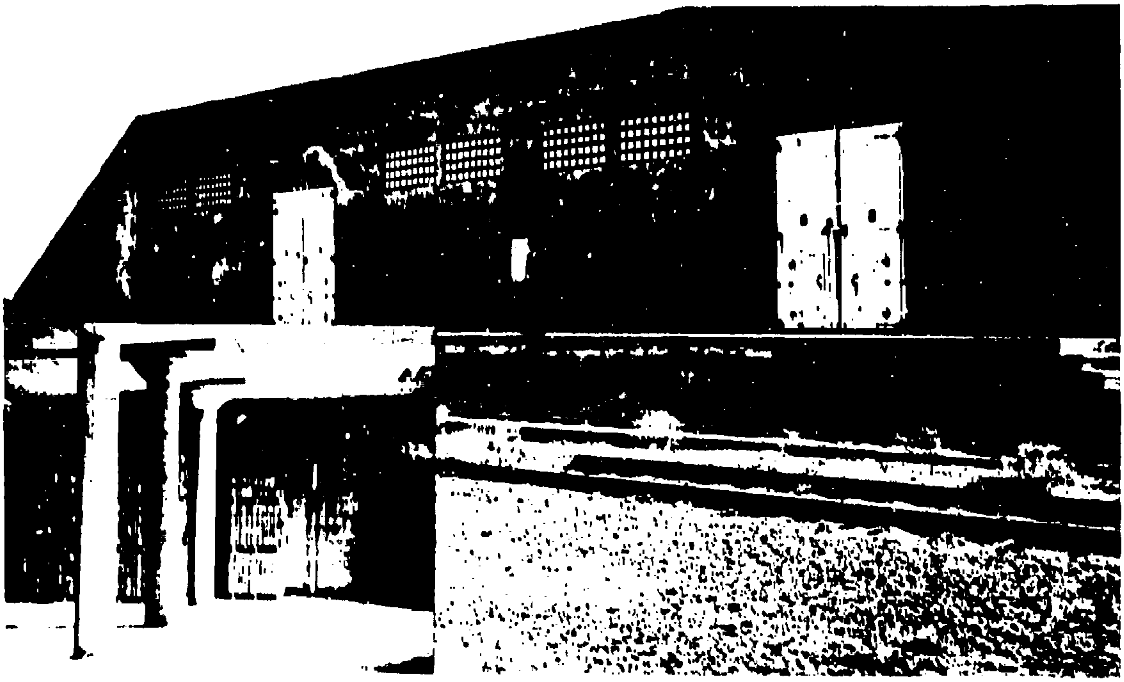

FIG. 10. PC Rectangular Magazine, Hawthorne.

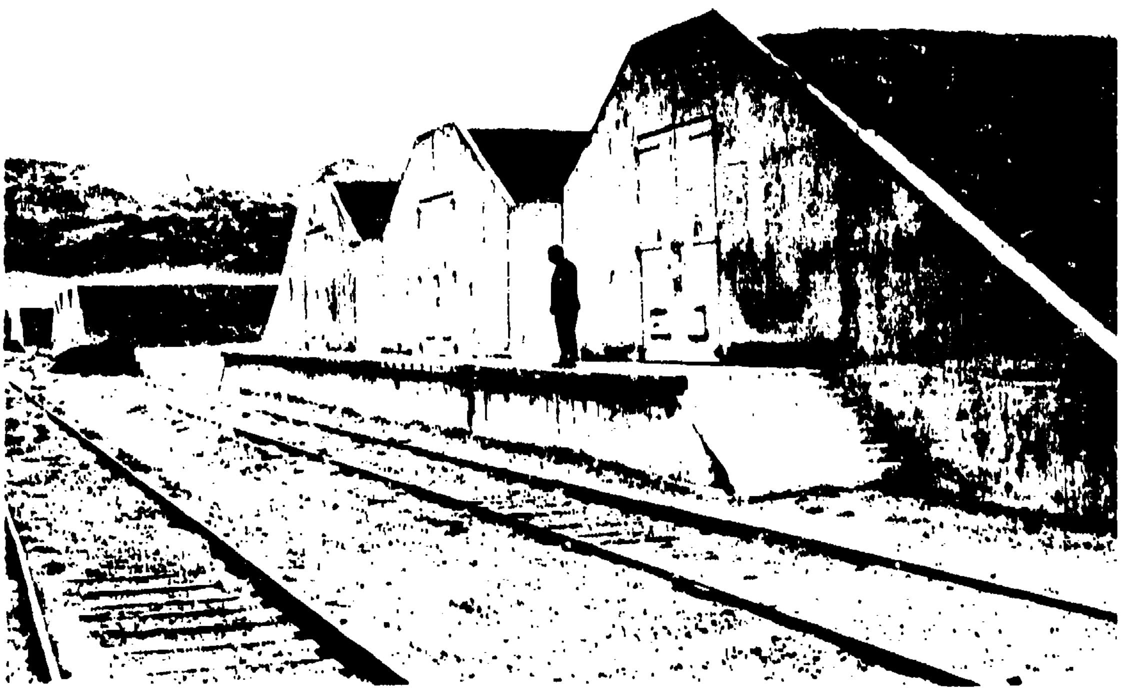

FIG. 11. PC Triple-Arch Magazines, Hawthorne.

ARMY PROVING GROUND, YUMA

There are seven ammunition storage magazines at the Army Proving Ground, Yuma, from which temperature data were taken. There are significant differences between the types of magazines at this installation, as indicated in Table 6. The temperatures between the structures also vary to some extent. The lowest readings during the hot season of the year were measured in Building 3551 (Fig. 12). The highest temperature readings were taken in a Transportainer Magazine, T3577, (Fig. 13). The photo insert in Fig. 13 shows the location of the temperature sensing device.

A comparison of Fig. 12 and 13 shows that there is a vast difference in the construction of the two magazines. In spite of this fact, the temperatures experienced by ordnance with either type of protection were not grossly (10°F) different.

TABLE 6. Storage Magazines at Yuma.

Bldg Ident.	Magazine number	Size[a], ft	Description
3551	—	10 x 18 x 10	Concrete floor, walls, rear, front. Earth-covered.
3505 3502 3506	3 6 2	10 x 60 x 12	Corrugated steel arch, concrete floor, earth-covered. Flimsy metal front.
T3577	9	6 x 6 1/2 x 6	Earth-covered "transportainer"
3702	14	24 x 40 x 11 1/2	18-feet long corrugated steel tunnel approximately 7 feet high. Corrugated steel arch, concrete floor, earth-covered.
3707	17	6 x 18 x 10	Concrete rear, walls, floor, ceiling, front earth-covered.

[a]Dimensions listed are width, length, and height, in that order.

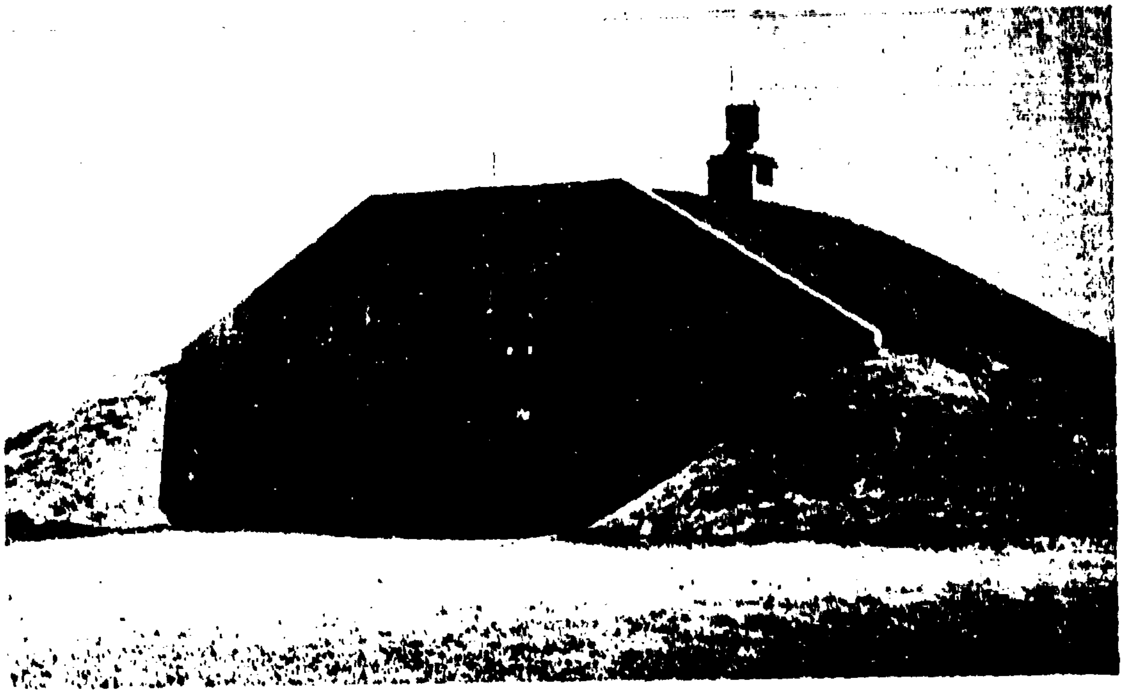

FIG. 12. Magazine 3551, Yuma.

FIG. 13. Transportainer Magazine, Yuma.

Appendix C

MONTHLY TEMPERATURE SUMMARIES

The monthly breakdown of the summary of results for each location is presented in Tables 7-9. The first row of each table contains column headings. Reading from the left, the first two column headings "YEAR" and "MONTH" are self-explanatory. "N" indicates the number of temperature readings taken during the month, the fourth through the ninth column labeled "The Number of Data Points Greater than or Equal to 80°F, 90°F, 100°F, 105°F, 110°F, and 115°F" is self explanatory. "Reading Times" indicate the number of days within the month from which the temperatures were collected.

TABLE 7. Summary of Results, China Lake

YEAR	MONTH	N	THE NUMBER OF DATA POINTS GREATER THAN OR EQUAL TO						READING TIMES
			80°F	90°F	100°F	105°F	110°F	115°F	
1960	JAN	1520	0	0	0	0	0	0	20
1960	FEB	1520	0	0	0	0	0	0	20
1960	MAR	1758	6	0	0	0	0	0	24
1960	APR	1617	22	0	0	0	0	0	21
1960	MAY	1617	152	0	0	0	0	0	21
1960	JUN	1526	1426	248	0	0	0	0	23
1960	JUL	1540	1539	1019	0	0	0	0	20
1960	AUG	1694	1677	1266	0	0	0	0	22
1960	SEP	1617	1601	424	0	0	0	0	21
1960	OCT	308	180	3	0	0	0	0	4
1960	NOV	229	10	0	0	0	0	0	3
1960	DEC	308	4	0	0	0	0	0	4
1963	JAN	308	4	2	0	0	0	0	4
1963	FEB	308	4	2	0	0	0	0	4
1963	MAR	308	4	4	0	0	0	0	4
1963	APR	385	5	5	0	0	0	0	5
1963	MAY	307	48	0	0	0	0	0	4
1963	JUN	308	235	5	0	0	0	0	4
1963	JUL	308	384	123	0	0	0	0	5
1963	AUG	308	308	198	0	0	0	0	4
1963	SEP	385	384	53	0	0	0	0	5
1963	OCT	308	303	121	0	0	0	0	4
1963	NOV	154	3	3	0	0	0	0	2
1963	DEC	154	2	1	0	0	0	0	2
1964	JAN	308	4	2	0	0	0	0	4
1964	FEB	154	2	2	0	0	0	0	2
1964	MAR	231	1	0	0	0	0	0	3
1964	APR	308	0	0	0	0	0	0	4
1964	MAY	308	31	0	0	0	0	0	4
1964	JUN	381	265	7	0	0	0	0	5
1964	JUL	308	308	139	0	0	0	0	4
1964	AUG	308	308	250	0	0	0	0	4
1964	SEP	385	385	92	0	0	0	0	5
1964	OCT	307	290	3	0	0	0	0	4
1964	NOV	229	22	1	0	0	0	0	3
1964	DEC	385	2	2	0	0	0	0	5
1965	JAN	231	1	1	0	0	0	0	3
1965	FEB	305	1	0	0	0	0	0	4
1965	MAR	372	4	0	0	0	0	0	5
1965	APR	301	1	0	0	0	0	0	4
1965	MAY	300	47	0	0	0	0	0	4
1965	JUN	371	275	1	0	0	0	0	5
1965	JUL	302	299	80	0	0	0	0	4
1965	AUG	376	370	227	0	0	0	0	5
1965	NOV	377	10	0	0	0	0	0	5
1965	DEC	302	0	0	0	0	0	0	4
1966	JAN	74	0	0	0	0	0	0	1
1966	FEB	76	0	0	0	0	0	0	1

TABLE 8. Summary of Results, Hawthorne.

YEAR	MONTH	N	THE NUMBER OF DATA POINTS GREATER THAN OR EQUAL TO						READING TIMES
			80°F	90°F	100°F	105°F	110°F	115°F	
1959	JAN	158	0	0	0	0	0	0	4
1959	FEB	327	1	0	0	0	0	0	5
1959	MAR	231	0	0	0	0	0	0	5
1959	APR	459	0	0	0	0	0	0	7
1959	MAY	908	0	0	0	0	0	0	11
1959	JUN	1046	330	0	0	0	0	0	12
1959	JUL	903	853	3	0	0	0	0	10
1959	AUG	853	833	3	0	0	0	0	9
1959	SEP	827	163	1	0	0	0	0	9
1959	OCT	403	24	0	0	0	0	0	7
1959	NOV	333	3	0	0	0	0	0	5
1959	DEC	198	0	0	0	0	0	0	2
1960	JAN	387	1	1	0	0	0	0	6
1960	FEB	213	4	0	0	0	0	0	4
1960	MAR	398	4	0	0	0	0	0	8
1960	APR	210	8	0	0	0	0	0	4
1960	MAY	1139	7	1	0	0	0	0	13
1960	JUN	1022	263	0	0	0	0	0	13
1960	JUL	804	779	0	0	0	0	0	11
1960	AUG	1128	058	4	0	0	0	0	12
1960	SEP	783	268	4	0	0	0	0	9
1960	OCT	485	17	0	0	0	0	0	8
1960	NOV	180	3	1	0	0	0	0	3
1960	DEC	396	0	0	0	0	0	0	7
1961	JAN	214	2	0	0	0	0	0	3
1961	FEB	383	0	0	0	0	0	0	5
1961	MAR	360	2	0	0	0	0	0	6
1961	APR	215	2	1	0	0	0	0	3
1961	MAY	601	6	0	0	0	0	0	12
1961	JUN	637	250	1	0	0	0	0	11
1961	JUL	529	527	1	0	0	0	0	8
1961	AUG	500	486	9	0	0	0	0	11
1961	SEP	503	282	1	0	0	0	0	8
1961	OCT	442	12	0	0	0	0	0	5
1961	NOV	212	0	0	0	0	0	0	5
1961	DEC	281	0	0	0	0	0	0	5
1962	JAN	357	0	0	0	0	0	0	7
1962	FEB	354	0	0	0	0	0	0	7
1962	MAR	568	0	0	0	0	0	0	8
1962	APR	299	0	0	0	0	0	0	6
1962	MAY	568	6	0	0	0	0	0	8
1962	JUN	519	38	0	0	0	0	0	7
1962	JUL	550	530	0	0	0	0	0	13
1962	AUG	537	536	0	0	0	0	0	10
1962	SEP	506	372	0	0	0	0	0	9
1962	OCT	382	44	0	0	0	0	0	13
1962	NOV	380	8	0	0	0	0	0	12
1962	DEC	280	0	0	0	0	0	0	11

TABLE 8. Summary of Results, Hawthorne (Contd.)

YEAR	MONTH	N	THE NUMBER OF DATA POINTS GREATER THAN OR EQUAL TO						READING TIMES
			80°F	90°F	100°F	105°F	110°F	115°F	
1963	JAN	599	0	0	0	0	0	0	18
1963	FEB	820	0	0	0	0	0	0	19
1963	MAR	725	0	0	0	0	0	0	20
1963	APR	782	0	0	0	0	0	0	20
1963	MAY	1107	2	0	0	0	0	0	20
1963	JUN	1106	19	0	0	0	0	0	20
1963	JUL	928	652	0	0	0	0	0	21
1963	AUG	1041	973	0	0	0	0	0	22
1963	SEP	761	325	0	0	0	0	0	19
1963	OCT	771	39	0	0	0	0	0	23
1963	NOV	594	0	0	0	0	0	0	18
1963	DEC	670	0	0	0	0	0	0	17
1964	JAN	971	0	0	0	0	0	0	22
1964	FEB	706	1	0	0	0	0	0	19
1964	MAR	896	3	0	0	0	0	0	22
1964	APR	1003	3	0	0	0	0	0	22
1964	MAY	926	2	0	0	0	0	0	18
1964	JUN	1074	9	0	0	0	0	0	22
1964	JUL	1208	939	0	0	0	0	0	22
1964	AUG	1001	60	3	0	0	0	0	19
1964	SEP	858	302	2	0	0	0	0	18

TABLE 9. Summary of Results, Yuma.

YEAR	MONTH	N	THE NUMBER OF DATA POINTS GREATER THAN OR EQUAL TO						READING TIMES
			80°F	90°F	100°F	105°F	110°F	115°F	
1957	JUL	27	27	27	0	0	0	0	9
1957	AUG	93	93	93	2	0	0	0	31
1957	SEP	87	87	52	0	0	0	0	30
1957	OCT	85	45	2	0	0	0	0	31
1957	NOV	90	0	0	0	0	0	0	30
1957	DEC	90	0	0	0	0	0	0	31
1958	JAN	93	0	0	0	0	0	0	31
1958	FEB	82	0	0	0	0	0	0	28
1958	MAR	93	0	0	0	0	0	0	31
1958	APR	90	9	0	0	0	0	0	30
1958	MAY	93	80	20	0	0	0	0	31
1958	JUN	86	86	68	0	0	0	0	30
1958	JUL	90	0	90	16	1	0	0	31
1958	AUG	88	[illegible]	86	1	0	0	0	31
1958	SEP	85	85	66	6	0	0	0	30
1958	OCT	89	83	6	0	0	0	0	31
1958	NOV	90	0	0	0	0	0	0	30
1958	DEC	87	0	0	0	0	0	0	31

TABLE 9. Summary of Results, Yuma (Contd.)

YEAR	MONTH	N	THE NUMBER OF DATA POINTS GREATER THAN OR EQUAL TO						READING TIMES
			80°F	90°F	100°F	105°F	110°F	115°F	
1959	JAN	92	0	0	0	0	0	0	31
1959	FEB	82	0	0	0	0	0	0	28
1959	MAR	86	1	0	0	0	0	0	31
1959	APR	82	22	0	0	0	0	0	30
1959	MAY	124	89	21	4	0	0	0	31
1959	JUN	120	14	57	27	11	11	0	30
1959	JUL	119	119	26	56	21	15	1	31
1959	AUG	124	124	56	56	12	0	0	31
1959	SEP	120	120	79	29	19	0	0	30
1959	OCT	92	82	2	0	0	0	0	31
1959	NOV	87	0	0	0	0	0	0	30
1959	DEC	84	0	0	0	0	0	0	31
1960	JAN	215	0	0	0	0	0	0	31
1960	FEB	196	0	0	0	0	0	0	28
1960	MAR	217	10	0	0	0	0	0	31
1960	APR	208	93	89	0	0	0	0	30
1960	MAY	217	193	50	3	1	0	0	31
1960	JUN	181	181	163	43	13	6	1	30
1960	JUL	217	217	217	140	37	10	1	31
1960	AUG	211	211	211	131	30	2	0	31
1960	SEP	206	206	206	24	0	0	0	30
1960	OCT	155	138	57	0	0	0	0	31
1960	NOV	144	35	0	0	0	0	0	30
1960	DEC	152	0	0	0	0	0	0	31
1961	JAN	155	0	0	0	0	0	0	2
1961	FEB	140	0	0	0	0	0	0	28
1961	MAR	123	2	0	0	0	0	0	31
1961	APR	98	38	2	0	0	0	0	30
1961	MAY	143	129	15	0	0	0	0	31
1961	JUN	146	146	110	25	17	8	0	30
1961	JUL	154	154	154	[illegible]	19	0	0	31
1961	AUG	152	152	152	70	6	0	0	31
1961	SEP	144	144	120	9	0	0	0	30
1961	OCT	153	123	36	1	0	0	0	28
1961	NOV	138	2	0	0	0	0	0	30
1961	DEC	153	0	0	0	0	0	0	31
1962	JAN	149	0	0	0	0	0	0	31
1962	FEB	136	0	0	0	0	0	0	28
1962	MAR	152	4	0	0	0	0	0	21
1962	APR	141	79	9	0	0	0	0	30
1962	MAY	155	143	23	1	0	0	0	31
1962	JUN	135	135	87	12	1	0	0	30
1962	JUL	149	149	149	68	4	0	0	31
1962	AUG	127	128	127	96	18	0	0	29
1962	SEP	135	135	135	55	6	0	0	30
1962	OCT	142	139	52	0	0	0	0	31
1962	NOV	133	51	1	0	0	0	0	30
1962	DEC	148	0	0	0	0	0	0	31

TABLE 9. Summary of Results, Yuma (Contd.)

YEAR	MONTH	N	THE NUMBER OF DATA POINTS GREATER THAN OR EQUAL TO						READING TIMES
			80°F	90°F	100°F	105°F	110°F	115°F	
1963	JAN	155	0	0	0	0	0	0	31
1963	FEB	140	1	0	0	0	0	0	28
1963	MAR	147	2	0	0	0	0	0	31
1963	APR	150	10	1	0	0	0	0	30
1963	MAY	151	134	25	0	0	0	0	31
1963	JUN	141	140	71	0	0	0	0	30
1963	JUL	151	149	141	49	16	0	0	31
1963	AUG	155	155	155	37	2	0	0	31
1963	SEP	150	150	147	4	0	0	0	30
1963	OCT	139	136	50	0	0	0	0	31
1963	NOV	150	26	0	0	0	0	0	30
1963	DEC	155	0	0	0	0	0	0	31
1964	JAN	148	0	0	0	0	0	0	31
1964	FEB	145	0	0	0	0	0	0	28
1964	MAR	154	0	0	0	0	0	0	31
1964	APR	119	18	0	0	0	0	0	30
1964	MAY	120	69	4	0	0	0	0	31
1964	JUN	94	94	56	7	0	0	0	30
1964	JUL	93	93	75	40	4	0	0	31
1964	AUG	124	124	124	53	0	0	0	31
1964	SEP	100	92	92	5	0	0	0	30
1964	OCT	121	119	52	0	0	0	0	31
1964	NOV	90	31	0	0	0	0	0	30
1964	DEC	117	0	0	0	0	0	0	31
1965	JAN	215	0	0	0	0	0	0	31
1965	FEB	194	0	0	0	0	0	0	28
1965	MAR	217	0	0	0	0	0	0	31
1965	APR	192	46	14	0	0	0	0	30
1965	MAY	209	184	30	0	0	0	0	31
1965	JUN	216	216	87	8	0	0	0	30

Appendix D

TEMPERATURE STATISTICS

The standard deviation given along with the average maximum and average minimum temperatures is a measure of dispersion (precision, reproducibility, spread, scatter, etc.) of temperatures within the month. If it is assumed that the temperature readings within each month are dispersed normally (Gaussian distribution) then the standard deviation (σ), can easily be used for calculating the percentage of temperature readings that would exceed nominal temperatures. The Gaussian distribution is a group of measurements that is symmetrical about the average. That is, the spread of measurements below and above the average would appear as equally descending bell-shaped curves on either side of the average.[2] Skewness is a term used to define the degree of departure from the symmetrical bell-shaped curve. Figure 14 presents this Gaussian information. The distributions for within-month temperatures differ from month to month in that the skewness of these distributions differ. However, the skewness is never so extreme that the assumption of normality, which can easily provide the prediction of approximate percentage points, can be discarded.

Temperature averages for the three storage sites under consideration in this report are given in Tables 10-12. An explanation of the symbols is as follows:

D - date, followed by month and year

LOC = Location; i.e., C.L. = China Lake

N = Number of data points measured

X = Average

SD = Standard deviation

LT = Low temperature (minimum)

HT = High temperature (maximum)

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[2] For a Gaussian distribution, the average (μ) minus 1 standard deviation (σ) to the average (μ) plus 1 standard deviation (σ), that is $\mu \pm 1\sigma$, includes approximately 68 percent of all the values of the distribution. Similarly $\mu \pm 2\sigma$ covers 95 percent and $\mu \pm 3\sigma$ covers 99 percent of all the values of the distribution.

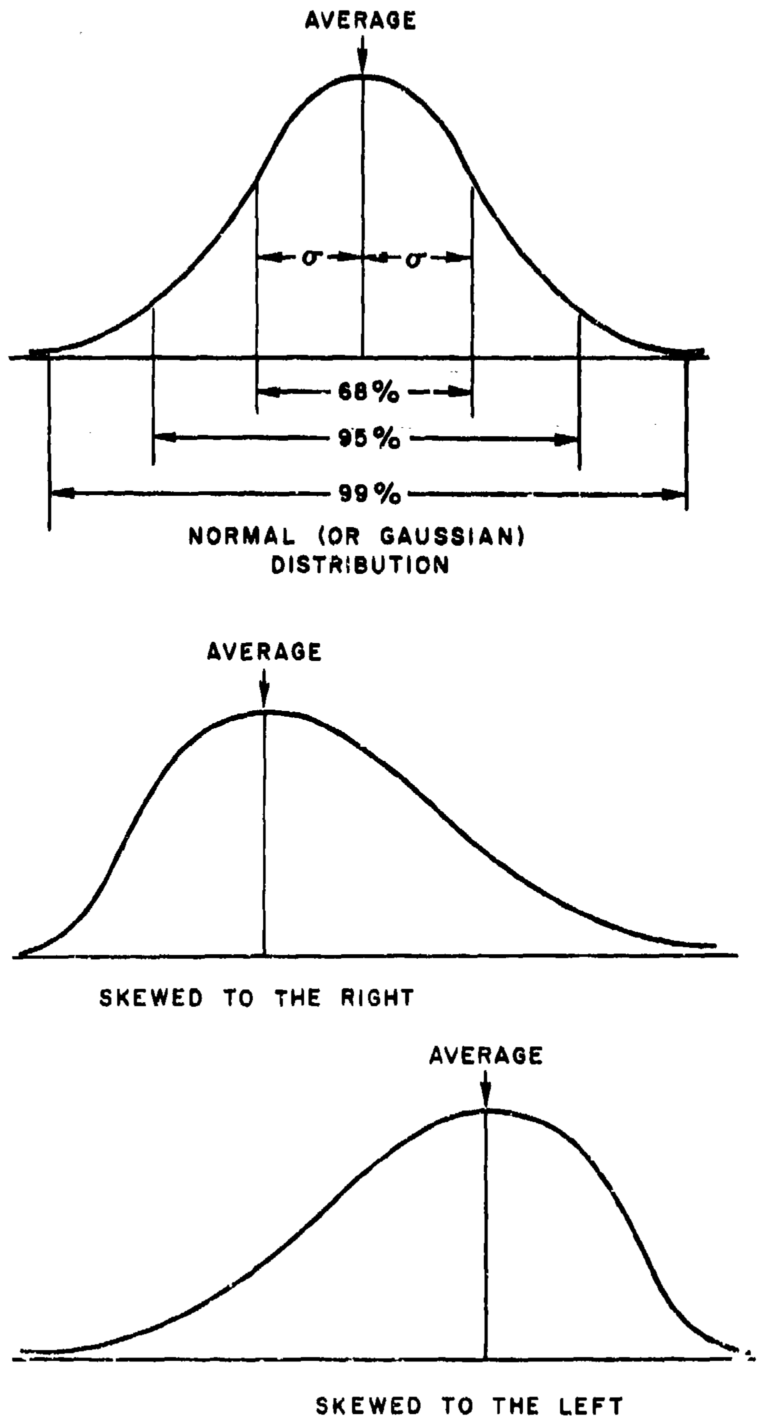

FIG. 14. Gaussian Distribution and Skewed Distributions.

TABLE 10. Minimum and Maximum Storage Temperature, Monthly Summaries, China Lake

D	01	60	LOC	C.L.	N	1520	X	50.07	SD	3.326	LT
D	01	60	LOC	C.L.	N	1520	X	52.52	SD	3.090	HT
D	02	60	LOC	C.L.	N	1520	X	52.56	SD	2.477	LT
D	02	60	LOC	C.L.	N	1520	X	55.63	SD	2.613	HT
D	03	60	LOC	C.L.	N	1758	X	58.93	SD	4.003	LT
D	03	60	LOC	C.L.	N	1758	X	62.78	SD	4.704	HT
D	04	60	LOC	C.L.	N	1617	X	66.40	SD	2.765	LT
D	04	60	LOC	C.L.	N	1617	X	70.73	SD	3.445	HT
D	05	60	LOC	C.L.	N	1617	X	70.00	SD	3.111	LT
D	05	60	LOC	C.L.	N	1617	X	74.56	SD	3.742	HT
D	06	60	LOC	C.L.	N	1526	X	80.92	SD	3.206	LT
D	06	60	LOC	C.L.	N	1526	X	85.34	SD	3.876	HT
D	07	60	LOC	C.L.	N	1540	X	86.79	SD	2.304	LT
D	07	60	LOC	C.L.	N	1540	X	90.71	SD	2.818	HT
D	08	60	LOC	C.L.	N	1694	X	87.52	SD	2.519	LT
D	08	60	LOC	C.L.	N	1694	X	91.32	SD	2.897	HT
D	09	60	LOC	C.L.	N	1617	X	84.10	SD	3.306	LT
D	09	60	LOC	C.L.	N	1617	X	87.75	SD	3.435	HT
D	10	60	LOC	C.L.	N	0308	X	74.89	SD	6.149	LT
D	10	60	LOC	C.L.	N	0308	X	80.62	SD	6.287	HT
D	11	60	LOC	C.L.	N	0229	X	67.37	SD	4.527	LT
D	11	60	LOC	C.L.	N	0229	X	73.07	SD	3.736	HT
D	12	60	LOC	C.L.	N	0308	X	54.81	SD	4.435	LT
D	12	60	LOC	C.L.	N	0308	X	61.04	SD	5.452	HT
D	01	63	LOC	C.L.	N	0308	X	48.38	SD	4.856	LT
D	01	63	LOC	C.L.	N	0308	X	54.38	SD	5.377	HT
D	02	63	LOC	C.L.	N	0308	X	54.87	SD	3.900	LT
D	02	63	LOC	C.L.	N	0308	X	60.80	SD	4.206	HT
D	03	63	LOC	C.L.	N	0308	X	56.94	SD	3.163	LT
D	03	63	LOC	C.L.	N	0308	X	63.87	SD	4.084	HT
D	04	63	LOC	C.L.	N	0385	X	58.60	SD	3.032	LT
D	04	63	LOC	C.L.	N	0385	X	65.94	SD	3.782	HT
D	05	63	LOC	C.L.	N	0307	X	67.91	SD	3.967	LT
D	05	63	LOC	C.L.	N	0307	X	75.56	SD	3.509	HT
D	06	63	LOC	C.L.	N	0308	X	74.07	SD	2.220	LT
D	06	63	LOC	C.L.	N	0308	X	81.71	SD	3.273	HT
D	07	63	LOC	C.L.	N	0308	X	80.98	SD	3.353	LT
D	07	63	LOC	C.L.	N	0308	X	87.39	SD	4.006	HT
D	08	63	LOC	C.L.	N	0308	X	84.57	SD	1.872	LT
D	08	63	LOC	C.L.	N	0308	X	90.10	SD	2.289	HT
D	09	63	LOC	C.L.	N	0385	X	80.93	SD	2.923	LT
D	09	63	LOC	C.L.	N	0385	X	86.35	SD	2.691	HT
D	10	63	LOC	C.L.	N	0308	X	75.17	SD	3.832	LT
D	10	63	LOC	C.L.	N	0308	X	80.92	SD	4.239	HT
D	11	63	LOC	C.L.	N	0154	X	66.36	SD	7.207	LT
D	11	63	LOC	C.L.	N	0154	X	73.81	SD	2.937	HT
D	12	63	LOC	C.L.	N	0154	X	55.61	SD	5.111	LT
D	12	63	LOC	C.L.	N	0154	X	63.66	SD	4.914	HT

TABLE 10. Minimum and Maximum Storage Temperature, Monthly Summaries, China Lake (Contd.)

D	01	64	LOC	C.L.	N	0308	X	49.79	SD	4.319	LT
D	01	64	LOC	C.L.	N	0308	X	55.29	SD	4.749	HT
D	02	64	LOC	C.L.	N	0134	X	51.22	SD	5.161	LT
D	02	64	LOC	C.L.	N	0134	X	55.87	SD	5.331	HT
D	03	64	LOC	C.L.	N	0231	X	53.52	SD	3.146	LT
D	03	64	LOC	C.L.	N	0231	X	62.45	SD	3.414	HT
D	04	64	LOC	C.L.	N	0308	X	60.12	SD	2.797	LT
D	04	64	LOC	C.L.	N	0308	X	68.23	SD	3.583	HT
D	05	64	LOC	C.L.	N	0308	X	64.32	SD	5.408	LT
D	05	64	LOC	C.L.	N	0308	X	73.13	SD	4.581	HT
D	06	64	LOC	C.L.	N	0381	X	73.43	SD	3.832	LT
D	06	64	LOC	C.L.	N	0381	X	81.45	SD	3.559	HT
D	07	64	LOC	C.L.	N	0308	X	83.03	SD	2.628	LT
D	07	64	LOC	C.L.	N	0308	X	88.71	SD	3.417	HT
D	08	64	LOC	C.L.	N	0308	X	86.23	SD	2.096	LT
D	08	64	LOC	C.L.	N	0308	X	91.51	SD	2.336	HT
D	09	64	LOC	C.L.	N	0385	X	81.18	SD	2.363	LT
D	09	64	LOC	C.L.	N	0385	X	87.24	SD	2.997	HT
D	10	64	LOC	C.L.	N	0307	X	77.98	SD	3.117	LT
D	10	64	LOC	C.L.	N	0307	X	83.12	SD	2.665	HT
D	11	64	LOC	C.L.	N	0229	X	62.69	SD	6.785	LT
D	11	64	LOC	C.L.	N	0229	X	71.64	SD	6.915	HT
D	12	64	LOC	C.L.	N	0385	X	55.94	SD	4.373	LT
D	12	64	LOC	C.L.	N	0385	X	62.70	SD	4.450	HT
D	01	65	LOC	C.L.	N	0231	X	52.43	SD	3.605	LT
D	01	65	LOC	C.L.	N	0231	X	58.29	SD	4.232	HT
D	02	65	LOC	C.L.	N	0305	X	53.77	SD	3.870	LT
D	02	65	LOC	C.L.	N	0305	X	59.73	SD	3.562	HT
D	03	65	LOC	C.L.	N	0372	X	56.88	SD	3.094	LT
D	03	65	LOC	C.L.	N	0372	X	62.59	SD	3.472	HT
D	04	65	LOC	C.L.	N	0301	X	57.72	SD	4.407	LT
D	04	65	LOC	C.L.	N	0301	X	65.23	SD	5.027	HT
D	05	65	LOC	C.L.	N	0300	X	67.13	SD	3.637	LT
D	05	65	LOC	C.L.	N	0300	X	75.37	SD	3.799	HT
D	06	65	LOC	C.L.	N	0371	X	73.92	SD	2.323	LT
D	06	65	LOC	C.L.	N	0371	X	81.10	SD	2.887	HT
D	07	65	LOC	C.L.	N	0302	X	81.48	SD	5.501	LT
D	07	65	LOC	C.L.	N	0302	X	87.35	SD	5.754	HT
D	08	65	LOC	C.L.	N	0376	X	84.49	SD	2.387	LT
D	08	65	LOC	C.L.	N	0376	X	89.97	SD	2.849	HT
D	11	65	LOC	C.L.	N	377	X	66.08	SD	5.396	LT
D	11	65	LOC	C.L.	N	377	X	70.91	SD	4.662	HT
D	12	65	LOC	C.L.	N	302	X	54.42	SD	4.995	LT
D	12	65	LOC	C.L.	N	302	X	58.38	SD	4.335	HT
D	01	66	LOC	C.L.	N	74	X	50.11	SD	4.565	LT
D	01	66	LOC	C.L.	N	74	X	54.45	SD	3.705	HT
D	02	66	LOC	C.L.	N	76	X	49.58	SD	4.352	LT
D	02	66	LOC	C.L.	N	76	X	53.72	SD	3.646	HT

TABLE 11. Minimum and Maximum Storage Temperature, Monthly Summaries, Hawthorne

D	01	59	LOC	NEV	N	158	X	38.66	SD	2.932	LT
D	01	59	LOC	NEV	N	158	X	51.60	SD	7.310	HT
D	02	59	LOC	NEV	N	327	X	39.27	SD	1.788	LT
D	02	59	LOC	NEV	N	327	X	47.84	SD	3.224	HT
D	03	59	LOC	NEV	N	231	X	39.39	SD	2.229	LT
D	03	59	LOC	NEV	N	231	X	49.84	SD	2.465	HT
D	04	59	LOC	NEV	N	459	X	47.21	SD	5.001	LT
D	04	59	LOC	NEV	N	459	X	60.92	SD	2.736	HT
D	05	59	LOC	NEV	N	908	X	56.40	SD	3.439	LT
D	05	59	LOC	NEV	N	908	X	65.55	SD	2.121	HT
D	06	59	LOC	NEV	N	1046	X	67.05	SD	5.969	LT
D	06	59	LOC	NEV	N	1046	X	75.57	SD	5.392	HT
D	07	59	LOC	NEV	N	903	X	75.64	SD	4.272	LT
D	07	59	LOC	NEV	N	903	X	83.03	SD	2.232	HT
D	08	59	LOC	NEV	N	853	X	77.88	SD	2.744	LT
D	08	59	LOC	NEV	N	853	X	84.42	SD	2.202	HT
D	09	59	LOC	NEV	N	827	X	69.61	SD	4.257	LT
D	09	59	LOC	NEV	N	827	X	76.85	SD	4.696	HT
D	10	59	LOC	NEV	N	403	X	61.90	SD	2.094	LT
D	10	59	LOC	NEV	N	403	X	69.35	SD	5.140	HT
D	11	59	LOC	NEV	N	333	X	52.67	SD	3.583	LT
D	11	59	LOC	NEV	N	333	X	65.86	SD	4.388	HT
D	12	59	LOC	NEV	N	198	X	44.97	SD	1.946	LT
D	12	59	LOC	NEV	N	198	X	55.24	SD	2.664	HT
D	01	60	LOC	NEV	N	387	X	35.24	SD	2.866	LT
D	01	60	LOC	NEV	N	387	X	49.17	SD	5.767	HT
D	02	60	LOC	NEV	N	213	X	36.48	SD	2.456	LT
D	02	60	LOC	NEV	N	213	X	48.00	SD	5.653	HT
D	03	60	LOC	NEV	N	398	X	39.97	SD	4.219	LT
D	03	60	LOC	NEV	N	398	X	50.11	SD	6.353	HT
D	04	60	LOC	NEV	N	210	X	44.18	SD	6.033	LT
D	04	60	LOC	NEV	N	210	X	60.87	SD	5.476	HT
D	05	60	LOC	NEV	N	1139	X	55.49	SD	4.880	LT
D	05	60	LOC	NEV	N	1139	X	65.60	SD	3.901	HT
D	06	60	LOC	NEV	N	1022	X	68.18	SD	5.702	LT
D	06	60	LOC	NEV	N	1022	X	76.79	SD	3.345	HT
D	07	60	LOC	NEV	N	804	X	76.05	SD	5.275	LT
D	07	60	LOC	NEV	N	804	X	83.15	SD	2.054	HT
D	08	60	LOC	NEV	N	1128	X	76.65	SD	2.770	LT
D	08	60	LOC	NEV	N	1128	X	83.30	SD	2.134	HT
D	09	60	LOC	NEV	N	783	X	71.82	SD	4.329	LT
D	09	60	LOC	NEV	N	783	X	78.74	SD	3.423	HT
D	10	60	LOC	NEV	N	485	X	63.81	SD	6.965	LT
D	10	60	LOC	NEV	N	485	X	73.56	SD	5.244	HT
D	11	60	LOC	NEV	N	180	X	50.33	SD	2.442	LT
D	11	60	LOC	NEV	N	180	X	67.97	SD	7.341	HT
D	12	60	LOC	NEV	N	396	X	42.08	SD	3.254	LT
D	12	60	LOC	NEV	N	396	X	57.52	SD	7.756	HT

TABLE 11. Minimum and Maximum Storage Temperature, Monthly Summaries, Hawthorne (Contd.)

D	01	61	LOC	NEV	N	214	X	36.02	SD	2.574	LT
D	01	61	LOC	NEV	N	214	X	44.34	SD	3.673	HT
D	02	61	LOC	NEV	N	383	X	37.79	SD	2.718	LT
D	02	61	LOC	NEV	N	383	X	46.84	SD	5.690	HT
D	03	61	LOC	NEV	N	360	X	43.17	SD	3.681	LT
D	03	61	LOC	NEV	N	360	X	53.46	SD	4.459	HT
D	04	61	LOC	NEV	N	215	X	44.24	SD	4.062	LT
D	04	61	LOC	NEV	N	215	X	60.57	SD	4.745	HT
D	05	61	LOC	NEV	N	601	X	54.27	SD	4.750	LT
D	05	61	LOC	NEV	N	601	X	65.03	SD	3.451	HT
D	06	61	LOC	NEV	N	637	X	64.52	SD	7.937	LT
D	06	61	LOC	NEV	N	637	X	77.35	SD	5.127	HT
D	07	61	LOC	NEV	N	529	X	75.42	SD	3.968	LT
D	07	61	LOC	NEV	N	529	X	84.16	SD	1.691	HT
D	08	61	LOC	NEV	N	500	X	77.53	SD	2.915	LT
D	08	61	LOC	NEV	N	500	X	84.83	SD	2.465	HT
D	09	61	LOC	NEV	N	503	X	68.57	SD	5.168	LT
D	09	61	LOC	NEV	N	503	X	79.12	SD	5.063	HT
D	10	61	LOC	NEV	N	442	X	60.40	SD	4.553	LT
D	10	61	LOC	NEV	N	442	X	70.34	SD	5.552	HT
D	11	61	LOC	NEV	N	212	X	50.74	SD	4.332	LT
D	11	61	LOC	NEV	N	212	X	64.00	SD	6.583	HT
D	12	61	LOC	NEV	N	281	X	43.40	SD	2.651	LT
D	12	61	LOC	NEV	N	281	X	60.13	SD	8.111	HT
D	01	62	LOC	NEV	N	357	X	35.87	SD	3.103	LT
D	01	62	LOC	NEV	N	357	X	46.18	SD	3.708	HT
D	02	62	LOC	NEV	N	354	X	32.75	SD	3.351	LT
D	02	62	LOC	NEV	N	354	X	43.40	SD	1.818	HT
D	03	62	LOC	NEV	N	568	X	37.40	SD	4.503	LT
D	03	62	LOC	NEV	N	568	X	47.54	SD	3.785	HT
D	04	62	LOC	NEV	N	299	X	43.87	SD	5.967	LT
D	04	62	LOC	NEV	N	299	X	60.27	SD	3.981	HT
D	05	62	LOC	NEV	N	568	X	53.72	SD	6.653	LT
D	05	62	LOC	NEV	N	568	X	66.90	SD	3.045	HT
D	06	62	LOC	NEV	N	519	X	61.33	SD	6.880	LT
D	06	62	LOC	NEV	N	519	X	74.05	SD	3.695	HT
D	07	62	LOC	NEV	N	559	X	71.09	SD	7.206	LT
D	07	62	LOC	NEV	N	559	X	82.17	SD	1.725	HT
D	08	62	LOC	NEV	N	537	X	75.98	SD	2.271	LT
D	08	62	LOC	NEV	N	537	X	83.26	SD	1.327	HT
D	09	62	LOC	NEV	N	506	X	72.87	SD	2.001	LT
D	09	62	LOC	NEV	N	506	X	81.22	SD	2.734	HT
D	10	62	LOC	NEV	N	382	X	63.42	SD	4.487	LT
D	10	62	LOC	NEV	N	382	X	72.13	SD	6.679	HT
D	11	62	LOC	NEV	N	380	X	52.03	SD	3.615	LT
D	11	62	LOC	NEV	N	380	X	62.99	SD	9.015	HT
D	12	62	LOC	NEV	N	280	X	45.02	SD	2.027	LT
D	12	62	LOC	NEV	N	280	X	53.05	SD	5.871	HT

TABLE 11. Minimum and Maximum Storage Temperature, Monthly Summaries, Hawthorne (Contd.)

D	01	63	LOC	NEV	N	599	X	31.77	SD	3.738	LT
D	01	63	LOC	NEV	N	599	X	43.55	SD	7.397	HT
D	02	63	LOC	NEV	N	820	X	38.23	SD	5.805	LT
D	02	63	LOC	NEV	N	820	X	46.55	SD	4.600	HT
D	03	63	LOC	NEV	N	725	X	43.47	SD	2.911	LT
D	03	63	LOC	NEV	N	725	X	49.10	SD	3.008	HT
D	04	63	LOC	NEV	N	782	X	46.29	SD	3.070	LT
D	04	63	LOC	NEV	N	782	X	54.22	SD	2.410	HT
D	05	63	LOC	NEV	N	1107	X	56.39	SD	6.234	LT
D	05	63	LOC	NEV	N	1107	X	64.17	SD	3.910	HT
D	06	63	LOC	NEV	N	1106	X	63.24	SD	3.947	LT
D	06	63	LOC	NEV	N	1106	X	71.51	SD	3.297	HT
D	07	63	LOC	NEV	N	928	X	73.49	SD	7.765	LT
D	07	63	LOC	NEV	N	928	X	80.59	SD	2.680	HT
D	08	63	LOC	NEV	N	1041	X	77.33	SD	2.226	LT
D	08	63	LOC	NEV	N	1041	X	82.61	SD	1.908	HT
D	09	63	LOC	NEV	N	761	X	72.63	SD	2.472	LT
D	09	63	LOC	NEV	N	761	X	78.30	SD	3.965	HT
D	10	63	LOC	NEV	N	770	X	65.06	SD	4.027	LT
D	10	63	LOC	NEV	N	770	X	68.40	SD	5.187	HT
D	11	63	LOC	NEV	N	594	X	53.16	SD	3.814	LT
D	11	63	LOC	NEV	N	594	X	56.56	SD	3.321	HT
D	12	63	LOC	NEV	N	670	X	40.76	SD	2.006	LT
D	12	63	LOC	NEV	N	670	X	42.97	SD	1.981	HT
D	01	64	LOC	NEV	N	971	X	38.60	SD	1.998	LT
D	01	64	LOC	NEV	N	971	X	40.74	SD	1.658	HT
D	02	64	LOC	NEV	N	706	X	37.50	SD	1.420	LT
D	02	64	LOC	NEV	N	706	X	42.59	SD	6.179	HT
D	03	64	LOC	NEV	N	896	X	40.29	SD	2.897	LT
D	03	64	LOC	NEV	N	896	X	45.68	SD	3.962	HT
D	04	64	LOC	NEV	N	1003	X	47.64	SD	4.846	LT
D	04	64	LOC	NEV	N	1003	X	54.84	SD	4.066	HT
D	05	64	LOC	NEV	N	926	X	54.53	SD	7.054	LT
D	05	64	LOC	NEV	N	926	X	61.89	SD	5.797	HT
D	06	64	LOC	NEV	N	1074	X	62.26	SD	7.473	LT
D	06	64	LOC	NEV	N	1074	X	71.39	SD	3.236	HT
D	07	64	LOC	NEV	N	1208	X	75.52	SD	5.332	LT
D	07	64	LOC	NEV	N	1208	X	81.53	SD	2.568	HT
D	08	64	LOC	NEV	N	1001	X	77.96	SD	4.802	LT
D	08	64	LOC	NEV	N	1001	X	82.58	SD	1.844	HT
D	09	64	LOC	NEV	N	858	X	69.44	SD	2.771	LT
D	09	64	LOC	NEV	N	858	X	76.13	SD	5.745	HT

TABLE 12. Minimum and Maximum Storage Temperature, Monthly Summaries, Yuma

D	07	57	LOC	YUMA	N	0027	X	90.22	SD	1.050	LT
D	07	57	LOC	YUMA	N	0027	X	93.96	SD	1.891	HT
D	08	57	LOC	YUMA	N	0093	X	91.97	SD	1.790	LT
D	08	57	LOC	YUMA	N	0093	X	95.67	SD	2.061	HT
D	09	57	LOC	YUMA	N	0087	X	87.38	SD	2.436	LT
D	09	57	LOC	YUMA	N	0087	X	90.46	SD	2.569	HT
D	10	57	LOC	YUMA	N	0085	X	78.25	SD	4.012	LT
D	10	57	LOC	YUMA	N	0085	X	80.85	SD	4.213	HT
D	11	57	LOC	YUMA	N	0090	X	64.81	SD	4.391	LT
D	11	57	LOC	YUMA	N	0090	X	67.40	SD	3.671	HT
D	12	57	LOC	YUMA	N	0090	X	59.16	SD	1.614	LT
D	12	57	LOC	YUMA	N	0090	X	62.04	SD	1.586	HT
D	01	58	LOC	YUMA	N	0093	X	55.41	SD	1.765	LT
D	01	58	LOC	YUMA	N	0093	X	59.08	SD	1.740	HT
D	02	58	LOC	YUMA	N	0082	X	60.94	SD	1.939	LT
D	02	58	LOC	YUMA	N	0082	X	63.12	SD	1.946	HT
D	03	58	LOC	YUMA	N	0093	X	60.92	SD	3.080	LT
D	03	58	LOC	YUMA	N	0093	X	64.03	SD	3.098	HT
D	04	58	LOC	YUMA	N	0090	X	68.01	SD	5.456	LT
D	04	58	LOC	YUMA	N	0090	X	72.20	SD	5.571	HT
D	05	58	LOC	YUMA	N	0093	X	80.95	SD	4.851	LT
D	05	58	LOC	YUMA	N	0093	X	84.72	SD	4.794	HT
D	06	58	LOC	YUMA	N	0086	X	87.64	SD	2.463	LT
D	06	58	LOC	YUMA	N	0086	X	91.55	SD	2.699	HT
D	07	58	LOC	YUMA	N	0090	X	93.49	SD	1.609	LT
D	07	58	LOC	YUMA	N	0090	X	97.87	SD	2.142	HT
D	08	58	LOC	YUMA	N	0088	X	93.06	SD	3.094	LT
D	08	58	LOC	YUMA	N	0088	X	96.60	SD	2.693	HT
D	09	58	LOC	YUMA	N	0085	X	90.81	SD	4.612	LT
D	09	58	LOC	YUMA	N	0085	X	94.18	SD	4.362	HT
D	10	58	LOC	YUMA	N	0089	X	82.22	SD	3.463	LT
D	10	58	LOC	YUMA	N	0089	X	85.62	SD	3.617	HT
D	11	58	LOC	YUMA	N	0090	X	66.67	SD	5.888	LT
D	11	58	LOC	YUMA	N	0090	X	70.13	SD	4.956	HT
D	12	58	LOC	YUMA	N	0087	X	61.06	SD	3.721	LT
D	12	58	LOC	YUMA	N	0087	X	64.32	SD	3.674	HT
D	01	59	LOC	YUMA	N	0092	X	57.71	SD	2.052	LT
D	01	59	LOC	YUMA	N	0092	X	61.21	SD	2.105	HT
D	02	59	LOC	YUMA	N	0082	X	56.46	SD	2.218	LT
D	02	59	LOC	YUMA	N	0082	X	60.44	SD	1.951	HT
D	03	59	LOC	YUMA	N	0086	X	63.45	SD	3.051	LT
D	03	59	LOC	YUMA	N	0086	X	69.09	SD	3.818	HT
D	04	59	LOC	YUMA	N	0082	X	72.77	SD	2.486	LT
D	04	59	LOC	YUMA	N	0082	X	77.89	SD	3.322	HT
D	05	59	LOC	YUMA	N	124	X	79.35	SD	4.621	LT
D	05	59	LOC	YUMA	N	124	X	86.88	SD	5.655	HT
D	06	59	LOC	YUMA	N	120	X	90.63	SD	4.545	LT
D	06	59	LOC	YUMA	N	120	X	97.67	SD	6.871	HT

TABLE 12. Minimum and Maximum Storage Temperature Monthly Summaries, Yuma (Contd.)

D	07	59	LOC	YUMA	N	119	X	96.75	SD	2.366	LT
D	07	59	LOC	YUMA	N	119	X	103.10	SD	4.379	HT
D	08	59	LOC	YUMA	N	124	X	94.45	SD	3.289	LT
D	08	59	LOC	YUMA	N	124	X	99.96	SD	3.158	HT
D	09	59	LOC	YUMA	N	120	X	91.07	SD	5.524	LT
D	09	59	LOC	YUMA	N	120	X	96.96	SD	4.650	HT
D	10	59	LOC	YUMA	N	0092	X	78.65	SD	2.747	LT
D	10	59	LOC	YUMA	N	0092	X	82.38	SD	3.070	HT
D	11	59	LOC	YUMA	N	0087	X	68.87	SD	2.396	LT
D	11	59	LOC	YUMA	N	0087	X	72.82	SD	1.674	HT
D	12	59	LOC	YUMA	N	0084	X	60.04	SD	4.495	LT
D	12	59	LOC	YUMA	N	0084	X	63.43	SD	4.283	HT
D	01	60	LOC	YUMA	N	0215	X	53.82	SD	4.588	LT
D	01	60	LOC	YUMA	N	0215	X	56.91	SD	3.644	HT
D	02	60	LOC	YUMA	N	0196	X	58.19	SD	3.957	LT
D	02	60	LOC	YUMA	N	0196	X	62.24	SD	2.507	HT
D	03	60	LOC	YUMA	N	0217	X	65.92	SD	4.540	LT
D	03	60	LOC	YUMA	N	0217	X	71.36	SD	4.834	HT
D	04	60	LOC	YUMA	N	0208	X	73.13	SD	4.993	LT
D	04	60	LOC	YUMA	N	0208	X	79.54	SD	4.299	HT
D	05	60	LOC	YUMA	N	0217	X	80.11	SD	5.250	LT
D	05	60	LOC	YUMA	N	0217	X	85.65	SD	5.258	HT
D	06	60	LOC	YUMA	N	0181	X	89.76	SD	4.358	LT
D	06	60	LOC	YUMA	N	0181	X	96.18	SD	5.584	HT
D	07	60	LOC	YUMA	N	0217	X	95.22	SD	3.161	LT
D	07	60	LOC	YUMA	N	0217	X	101.26	SD	3.711	HT
D	08	60	LOC	YUMA	N	0211	X	95.44	SD	3.434	LT
D	08	60	LOC	YUMA	N	0211	X	100.65	SD	3.338	HT
D	09	60	LOC	YUMA	N	0206	X	91.54	SD	3.849	LT
D	09	60	LOC	YUMA	N	0206	X	96.22	SD	2.793	HT
D	10	60	LOC	YUMA	N	0155	X	82.50	SD	7.172	LT
D	10	60	LOC	YUMA	N	0155	X	86.69	SD	5.951	HT
D	11	60	LOC	YUMA	N	0144	X	71.57	SD	7.385	LT
D	11	60	LOC	YUMA	N	0144	X	75.34	SD	5.938	HT
D	12	60	LOC	YUMA	N	0152	X	59.78	SD	5.765	LT
D	12	60	LOC	YUMA	N	0152	X	63.54	SD	4.382	HT
D	01	61	LOC	YUMA	N	0155	X	60.17	SD	5.674	LT
D	01	61	LOC	YUMA	N	0155	X	64.06	SD	4.495	HT
D	02	61	LOC	YUMA	N	0140	X	62.20	SD	3.977	LT
D	02	61	LOC	YUMA	N	0140	X	67.08	SD	3.205	HT
D	03	61	LOC	YUMA	N	0123	X	65.24	SD	4.139	LT
D	03	61	LOC	YUMA	N	0123	X	70.42	SD	3.700	HT
D	04	61	LOC	YUMA	N	0098	X	71.66	SD	6.104	LT
D	04	61	LOC	YUMA	N	0098	X	78.54	SD	4.470	HT
D	05	61	LOC	YUMA	N	0143	X	77.83	SD	5.509	LT
D	05	61	LOC	YUMA	N	0143	X	84.41	SD	4.166	HT
D	06	61	LOC	YUMA	N	0146	X	87.62	SD	5.703	LT
D	06	61	LOC	YUMA	N	0146	X	94.97	SD	6.872	HT

TABLE 12. Minimum and Maximum Storage Temperature Monthly Summaries, Yuma (Contd.)

D	07	61	LOC	YUMA	N	0154	X	93.44	SD	4.537	LT
D	07	61	LOC	YUMA	N	0154	X	99.93	SD	3.666	HT
D	08	61	LOC	YUMA	N	0152	X	93.01	SD	3.086	LT
D	08	61	LOC	YUMA	N	0152	X	98.49	SD	3.330	HT
D	09	61	LOC	YUMA	N	0144	X	88.23	SD	5.331	LT
D	09	61	LOC	YUMA	N	0144	X	93.85	SD	4.124	HT
D	10	61	LOC	YUMA	N	0153	X	79.97	SD	5.958	LT
D	10	61	LOC	YUMA	N	0153	X	84.99	SD	6.057	HT
D	11	61	LOC	YUMA	N	0138	X	67.36	SD	4.800	LT
D	11	61	LOC	YUMA	N	0138	X	70.91	SD	4.114	HT
D	12	61	LOC	YUMA	N	0153	X	60.28	SD	4.810	LT
D	12	61	LOC	YUMA	N	0153	X	63.51	SD	4.039	HT
D	01	62	LOC	YUMA	N	0149	X	57.36	SD	4.834	LT
D	01	62	LOC	YUMA	N	0149	X	60.71	SD	3.968	HT
D	02	62	LOC	YUMA	N	0136	X	60.76	SD	4.413	LT
D	02	62	LOC	YUMA	N	0136	X	63.90	SD	2.918	HT
D	03	62	LOC	YUMA	N	0152	X	63.24	SD	4.046	LT
D	03	62	LOC	YUMA	N	0152	X	67.86	SD	4.487	HT
D	04	62	LOC	YUMA	N	0141	X	74.45	SD	3.598	LT
D	04	62	LOC	YUMA	N	0141	X	80.51	SD	5.618	HT
D	05	62	LOC	YUMA	N	0155	X	77.66	SD	3.674	LT
D	05	62	LOC	YUMA	N	0155	X	84.29	SD	4.896	HT
D	06	62	LOC	YUMA	N	0135	X	83.73	SD	6.681	LT
D	06	62	LOC	YUMA	N	0135	X	91.98	SD	5.348	HT
D	07	62	LOC	YUMA	N	0149	X	92.36	SD	4.436	LT
D	07	62	LOC	YUMA	N	0149	X	99.43	SD	3.107	HT
D	08	62	LOC	YUMA	N	0127	X	95.30	SD	3.983	LT
D	08	62	LOC	YUMA	N	0127	X	101.52	SD	2.751	HT
D	09	62	LOC	YUMA	N	0135	X	92.76	SD	4.308	LT
D	09	62	LOC	YUMA	N	0135	X	97.76	SD	4.139	HT
D	10	62	LOC	YUMA	N	0142	X	82.77	SD	6.122	LT
D	10	62	LOC	YUMA	N	0142	X	87.65	SD	4.710	HT
D	11	62	LOC	YUMA	N	0133	X	73.05	SD	5.843	LT
D	11	62	LOC	YUMA	N	0133	X	77.19	SD	5.429	HT
D	12	62	LOC	YUMA	N	0148	X	63.34	SD	5.086	LT
D	12	62	LOC	YUMA	N	0148	X	66.88	SD	4.122	HT
D	01	63	LOC	YUMA	N	0155	X	55.73	SD	4.583	LT
D	01	63	LOC	YUMA	N	0155	X	58.57	SD	3.691	HT
D	02	63	LOC	YUMA	N	0140	X	63.85	SD	2.652	LT
D	02	63	LOC	YUMA	N	0140	X	67.28	SD	3.558	HT
D	03	63	LOC	YUMA	N	0147	X	65.69	SD	2.859	LT
D	03	63	LOC	YUMA	N	0147	X	69.22	SD	3.198	HT
D	04	63	LOC	YUMA	N	0150	X	69.16	SD	2.208	LT
D	04	63	LOC	YUMA	N	0150	X	73.21	SD	3.668	HT
D	05	63	LOC	YUMA	N	0151	X	79.43	SD	3.573	LT
D	05	63	LOC	YUMA	N	0151	X	84.53	SD	4.557	HT
D	06	63	LOC	YUMA	N	0141	X	83.55	SD	4.801	LT
D	06	63	LOC	YUMA	N	0141	X	89.30	SD	3.917	HT

TABLE 12. Minimum and Maximum Storage Temperature Monthly Summaries, Yuma (Contd.)

D	07	63	LOC	YUMA	N	0151	X	92.68	SD	3.817	LT
D	07	63	LOC	YUMA	N	0151	X	97.71	SD	4.811	HT
D	08	63	LOC	YUMA	N	0155	X	92.92	SD	3.331	LT
D	08	63	LOC	YUMA	N	0155	X	97.36	SD	3.081	HT
D	09	63	LOC	YUMA	N	0150	X	89.99	SD	4.406	LT
D	09	63	LOC	YUMA	N	0150	X	94.53	SD	2.686	HT
D	10	63	LOC	YUMA	N	0139	X	83.42	SD	6.769	LT
D	10	63	LOC	YUMA	N	0139	X	87.53	SD	4.849	HT
D	11	63	LOC	YUMA	N	0150	X	70.59	SD	7.030	LT
D	11	63	LOC	YUMA	N	0150	X	74.63	SD	4.604	HT
D	12	63	LOC	YUMA	N	0155	X	60.32	SD	7.201	LT
D	12	63	LOC	YUMA	N	0155	X	64.63	SD	4.279	HT
D	01	64	LOC	YUMA	N	0148	X	54.95	SD	6.540	LT
D	01	64	LOC	YUMA	N	0148	X	59.36	SD	3.214	HT
D	02	64	LOC	YUMA	N	0145	X	57.52	SD	5.457	LT
D	02	64	LOC	YUMA	N	0145	X	62.39	SD	2.575	HT
D	03	64	LOC	YUMA	N	0154	X	60.00	SD	6.039	LT
D	03	64	LOC	YUMA	N	0154	X	64.32	SD	4.570	HT
D	04	64	LOC	YUMA	N	0119	X	69.35	SD	6.601	LT
D	04	64	LOC	YUMA	N	0119	X	74.96	SD	4.381	HT
D	05	64	LOC	YUMA	N	0120	X	74.97	SD	6.987	LT
D	05	64	LOC	YUMA	N	0120	X	80.98	SD	5.646	HT
D	06	64	LOC	YUMA	N	0094	X	85.60	SD	6.767	LT
D	06	64	LOC	YUMA	N	0094	X	91.30	SD	3.945	HT
D	07	64	LOC	YUMA	N	0093	X	91.55	SD	6.951	LT
D	07	64	LOC	YUMA	N	0093	X	96.68	SD	6.491	HT
D	08	64	LOC	YUMA	N	0124	X	93.70	SD	4.958	LT
D	08	64	LOC	YUMA	N	0124	X	98.48	SD	3.356	HT
D	09	64	LOC	YUMA	N	0100	X	89.58	SD	4.922	LT
D	09	64	LOC	YUMA	N	0100	X	94.36	SD	3.261	HT
D	10	64	LOC	YUMA	N	0121	X	84.55	SD	5.018	LT
D	10	64	LOC	YUMA	N	0121	X	88.63	SD	4.429	HT
D	11	64	LOC	YUMA	N	0090	X	70.67	SD	9.115	LT
D	11	64	LOC	YUMA	N	0090	X	74.20	SD	7.615	HT
D	12	64	LOC	YUMA	N	0117	X	60.74	SD	5.220	LT
D	12	64	LOC	YUMA	N	0117	X	63.58	SD	3.592	HT
D	01	65	LOC	YUMA	N	0215	X	59.16	SD	4.355	LT
D	01	65	LOC	YUMA	N	0215	X	61.85	SD	3.175	HT
D	02	65	LOC	YUMA	N	0194	X	60.57	SD	4.252	LT
D	02	65	LOC	YUMA	N	0194	X	63.90	SD	3.490	HT
D	03	65	LOC	YUMA	N	0217	X	63.06	SD	5.279	LT
D	03	65	LOC	YUMA	N	0217	X	67.61	SD	3.845	HT
D	04	65	LOC	YUMA	N	0192	X	70.25	SD	6.034	LT
D	04	65	LOC	YUMA	N	0192	X	74.57	SD	7.347	HT
D	05	65	LOC	YUMA	N	0209	X	78.70	SD	4.267	LT
D	05	65	LOC	YUMA	N	0209	X	84.24	SD	5.351	HT
D	06	65	LOC	YUMA	N	0216	X	83.85	SD	3.023	LT
D	06	65	LOC	YUMA	N	0216	X	89.78	SD	4.703	HT

Appendix E

STATISTICAL NOTES AND IMPLICATIONS

The following points concerning the data should be considered before making final judgement on the contents of the report.

1. The time intervals at which temperature readings were taken were not equal. The maximum and minimum temperature readings were those encountered within the magazine during those intervals of time. The difference in reading-time intervals biases the results in both maximum and minimum directions. It has been found that the temperatures in some magazines were read daily, weekly, or biweekly, depending on the material and procedures cogent to each facility. This, of course, will bias the results upward as a high temperature for one day may be the recorded temperature for that magazine for a one- or two-week period, instead of for that specific day.

2. The amount of ammunition in the storage magazines is not always constant. The absorption of heat by the ammunition (dependent on quantity of material) within the magazine could cause differences in temperature readings that are not accounted for.

3. The frequency at which the magazine doors are opened will also influence the temperature readings. This effect is also not accounted for.

4. The summary of results indicating the percentage of maximum temperature readings exceeding nominal temperature is exclusive of minimum temperature readings. Perhaps the minimum temperatures could be used in such a way as to provide the length of time which these nominal temperatures are exceeded. If, for example, the minimum temperature recorded for a reading interval is 90°F, it is certain that the temperature within the storage magazine was at least 90°F for that reading interval.

The number of data points, the averages, and the standard deviations of temperature readings for each month was reported in Appendix D because these statistics provide information concerning the distribution of temperature readings. Perhaps the only statistic that needs defining is the standard deviation. The standard deviation is a measure of dispersion of these temperature readings (in this case, it is about the estimated average). If it is assumed that these temperature measurements are normally distributed (the Gaussian curve) within each month, and the data do not indicate that it is a poor assumption for practical use, the standard deviation can be used to attach probabilities of occurrences to nominal temperature values. For example, in July 1959 at Yuma, the sample size is 119, the average high temperature is 103.1°F, and the standard deviation is 4.379°F. From this, if it is assumed that the data represent the storage temperatures encountered in July, then the probability of getting a storage temperature of 120°F or greater is approximately 0.001, or one chance in one thousand during July of any year.

Appendix F

EXPERIMENTAL STUDIES, YUMA

Temperature data collected at the Army Proving Ground from an above-ground corrugated steel building (40 x 100 x 14 feet) without insulation, JATO, (Fig. 15) and an outdoor tarpaulin-covered structure (Fig. 15) for the year 1961 are herein presented.

Temperatures from within these structures were taken for a temperature study which the Army is making. These data are presented here to present a better insight into the kind of temperature environment that ordnance may encounter under these particular storage conditions. It is interesting to note that the highest temperatures recorded for the steel structure (119°F) and the tarpaulin-covered structure (121°F) in comparison to the highest storage magazine temperature (116°F) is not grossly different.

The average maximum temperature plots for the corrugated steel building (Fig. 17) and the tarpaulin-covered structure (Fig. 18), and the data from which these plots were made (Tables 13 and 14) are herein presented. The symbols used are the same as those used in Appendix D.

It can be seen in Fig. 15 and 16, that there is no thermal mass protection (for example, dirt cover protection that absorbs heat) between the stored ammunition and direct solar exposure. The method of protection used, in this instance at Yuma, is simply to shield the ordnance from the rays of the sun. The major heat transfer is accomplished by conduction through the ambient air. The outside air is allowed free circulation within either storage facility therefore, the ammunition temperature cannot greatly exceed that of the outside air.

It is readily apparent that in the case of open dump storage, or other temporary storage situations, the type of shelter shown in Fig. 15 would reduce the high ordnance temperature to the order of the temperatures given in Table 14.

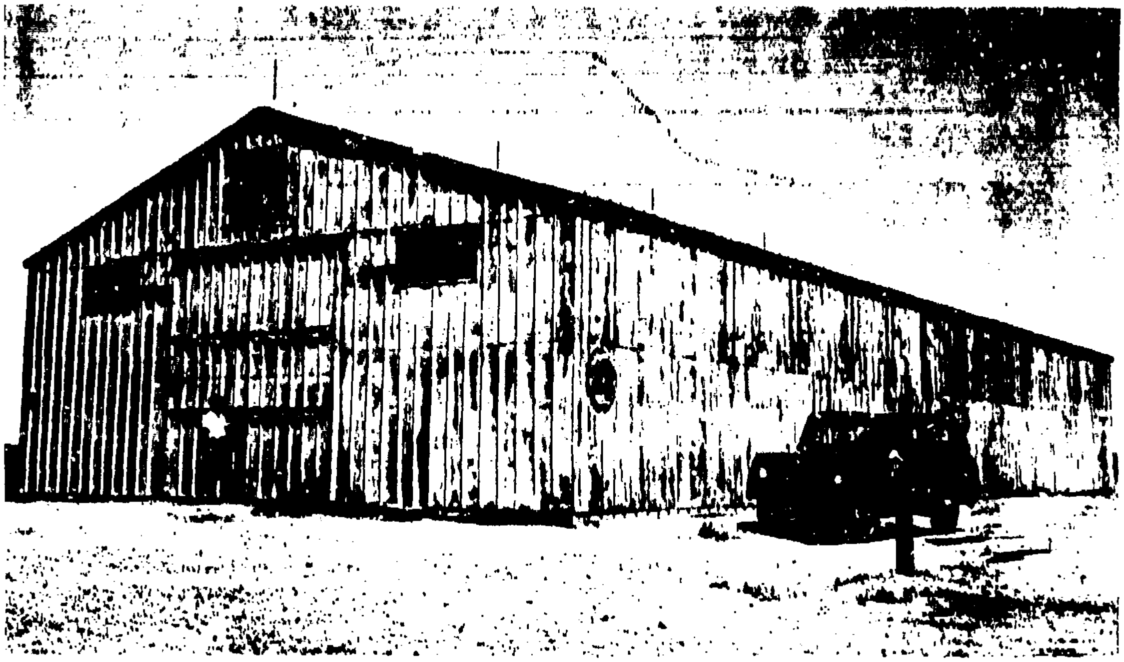

FIG. 15. JATO Storage Building, Yuma.

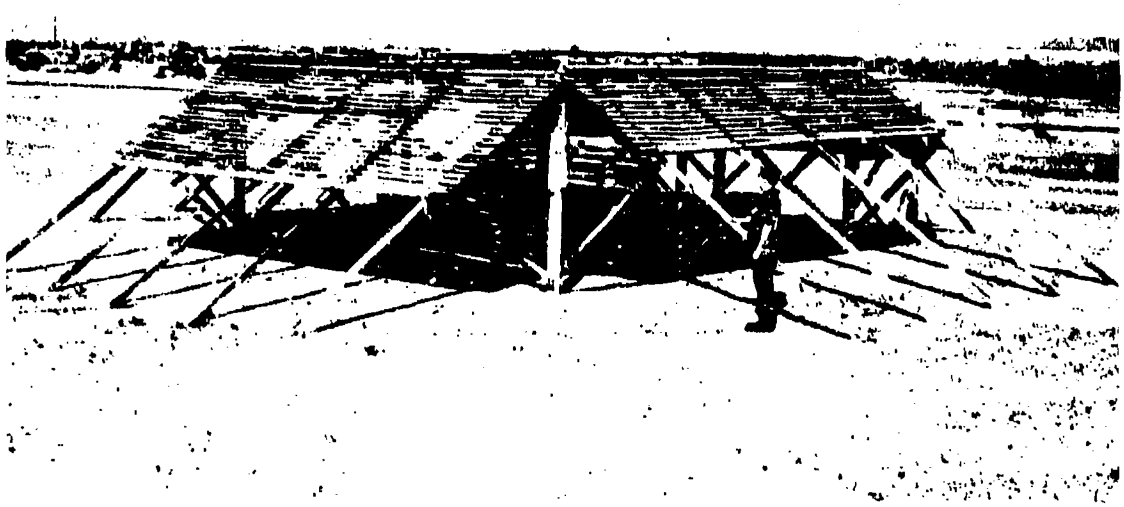

FIG. 16. X-Site Structure, Yuma.

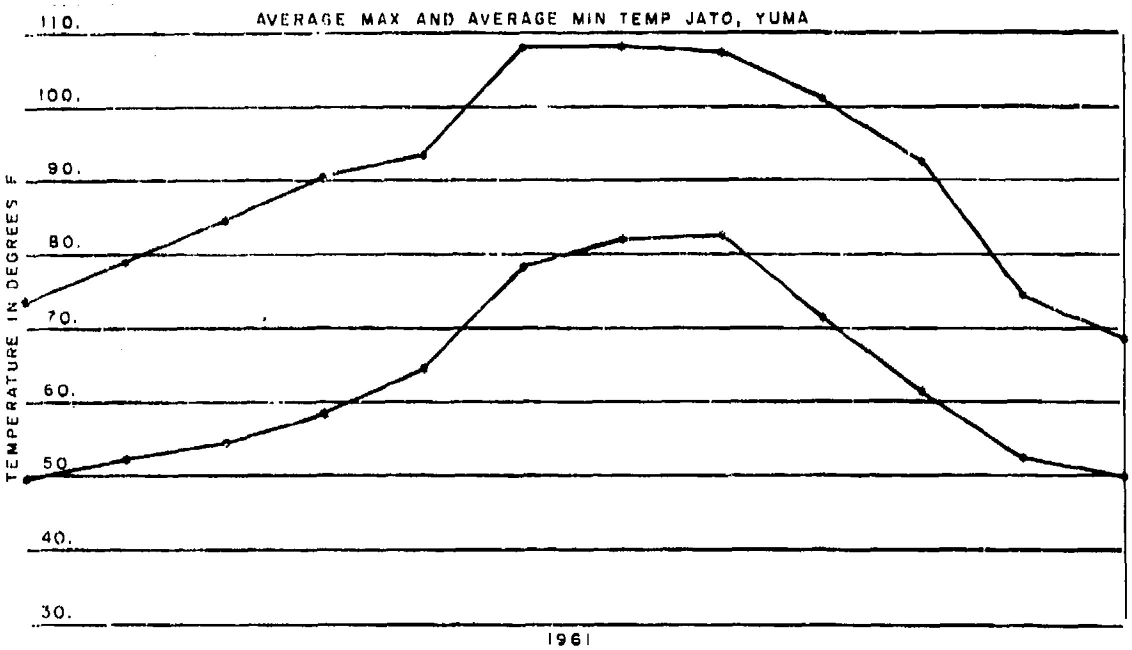

FIG. 17. Average Temperature, JATO, Yuma.

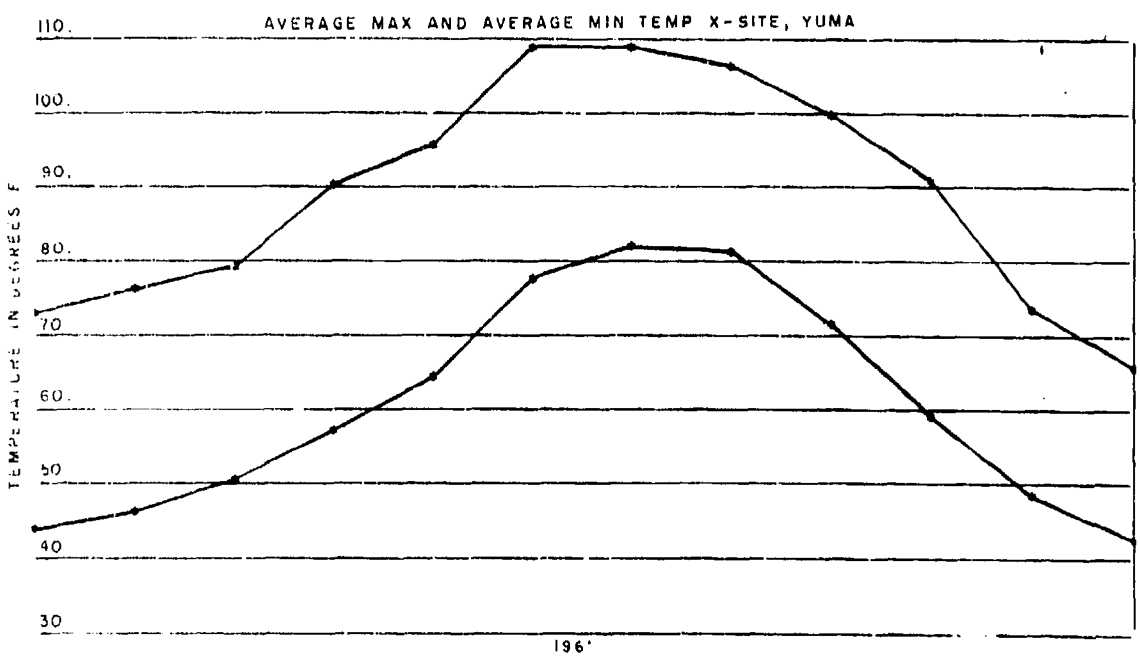

FIG. 18. Average Temperature, X-Site, Yuma.

TABLE 13. Minimum and Maximum Storage Temperature Monthly Summaries, JATO, Yuma

D	01	61	LOC	YUMA	JATO	N	31	X	49.39	SD	4.602	LT
D	01	61	LOC	YUMA	JATO	N	31	X	73.39	SD	7.008	HT
D	02	61	LOC	YUMA	JATO	N	28	X	52.14	SD	3.768	LT
D	02	61	LOC	YUMA	JATO	N	28	X	78.96	SD	4.780	HT
D	03	61	LOC	YUMA	JATO	N	23	X	54.43	SD	4.134	LT
D	03	61	LOC	YUMA	JATO	N	23	X	84.74	SD	6.837	HT
D	04	61	LOC	YUMA	JATO	N	17	X	58.29	SD	5.347	LT
D	04	61	LOC	YUMA	JATO	N	17	X	90.47	SD	7.383	HT
D	05	61	LOC	YUMA	JATO	N	31	X	64.42	SD	4.904	LT
D	05	61	LOC	YUMA	JATO	N	31	X	93.45	SD	6.087	HT
D	06	61	LOC	YUMA	JATO	N	30	X	78.17	SD	6.767	LT
D	06	61	LOC	YUMA	JATO	N	30	X	108.03	SD	7.753	HT
D	07	61	LOC	YUMA	JATO	N	31	X	82.03	SD	5.135	LT
D	07	61	LOC	YUMA	JATO	N	31	X	108.19	SD	4.607	HT
D	08	61	LOC	YUMA	JATO	N	31	X	82.58	SD	4.334	LT
D	08	61	LOC	YUMA	JATO	N	31	X	107.52	SD	4.781	HT
D	09	61	LOC	YUMA	JATO	N	27	X	71.41	SD	5.264	LT
D	09	61	LOC	YUMA	JATO	N	27	X	101.19	SD	5.463	HT
D	10	61	LOC	YUMA	JATO	N	31	X	61.26	SD	8.925	LT
D	10	61	LOC	YUMA	JATO	N	31	X	92.58	SD	11.260	HT
D	11	61	LOC	YUMA	JATO	N	27	X	52.26	SD	4.425	LT
D	11	61	LOC	YUMA	JATO	N	27	X	74.56	SD	5.423	HT
D	12	61	LOC	YUMA	JATO	N	31	X	49.90	SD	4.292	LT
D	12	61	LOC	YUMA	JATO	N	31	X	68.71	SD	6.629	HT

TABLE 14. Minimum and Maximum Storage Temperature Monthly Summaries, X-Site, Yuma

D	01	61	LOC	YUMA	X-S	N	31	X	43.84	SD	6.837	LT
D	01	61	LOC	YUMA	X-S	N	31	X	72.97	SD	6.661	HT
D	02	61	LOC	YUMA	X-S	N	28	X	46.18	SD	4.182	LT
D	02	61	LOC	YUMA	X-S	N	28	X	76.29	SD	4.783	HT
D	03	61	LOC	YUMA	X-S	N	31	X	50.48	SD	5.221	LT
D	03	61	LOC	YUMA	X-S	N	31	X	79.29	SD	6.487	HT
D	04	61	LOC	YUMA	X-S	N	30	X	57.10	SD	5.013	LT
D	04	61	LOC	YUMA	X-S	N	30	X	90.30	SD	9.075	HT
D	05	61	LOC	YUMA	X-S	N	27	X	64.37	SD	5.772	LT
D	05	61	LOC	YUMA	X-S	N	27	X	95.78	SD	6.015	HT
D	06	61	LOC	YUMA	X-S	N	24	X	77.63	SD	6.239	LT
D	06	61	LOC	YUMA	X-S	N	30	X	108.90	SD	7.331	HT
D	07	61	LOC	YUMA	X-S	N	31	X	81.94	SD	5.196	LT
D	07	61	LOC	YUMA	X-S	N	31	X	108.90	SD	5.275	HT
D	08	61	LOC	YUMA	X-S	N	31	X	81.19	SD	4.316	LT
D	08	61	LOC	YUMA	X-S	N	31	X	106.42	SD	4.931	HT
D	09	61	LOC	YUMA	X-S	N	30	X	71.53	SD	5.450	LT
D	09	61	LOC	YUMA	X-S	N	30	X	99.83	SD	5.344	HT
D	10	61	LOC	YUMA	X-S	N	31	X	59.06	SD	7.234	LT
D	10	61	LOC	YUMA	X-S	N	31	X	91.00	SD	10.529	HT
D	11	61	LOC	YUMA	X-S	N	30	X	48.40	SD	5.739	LT
D	11	61	LOC	YUMA	X-S	N	30	X	73.60	SD	5.876	HT
D	12	61	LOC	YUMA	X-S	N	31	X	42.55	SD	4.007	LT
D	12	61	LOC	YUMA	X-S	N	31	X	65.77	SD	7.593	HT

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13. ABSTRACT

Temperature measurements (162,000 data points) from the "explosive hazard magazines" in the desert regions of the Western United States at Yuma, Arizona, China Lake, California, and Hawthorne, Nevada, were assessed for the purpose of establishing temperature limit criteria by statistical methods for ordnance stored in hot desert magazines. This study shows that in the storage magazine environment, the 165°F specification temperature is grossly unrealistic. This report includes 17 figures and 14 tables.

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Storage Temperature of Explosive Hazard Magazines. Part 1. American Desert, by I. S. Kurotori and H. Schafer. China Lake, Calif., NOTS, November 1966. 40 pp. (NOTS TP 4143, Part 1).
ABSTRACT. Temperature measurements (162,000 data points) from the "explosive hazard magazines" in the desert regions of the Western United States at Yuma, Arizona, China Lake, California, and Hawthorne, Nevada, were assessed for the purpose of
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NOTS TP 4143
Part 1
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